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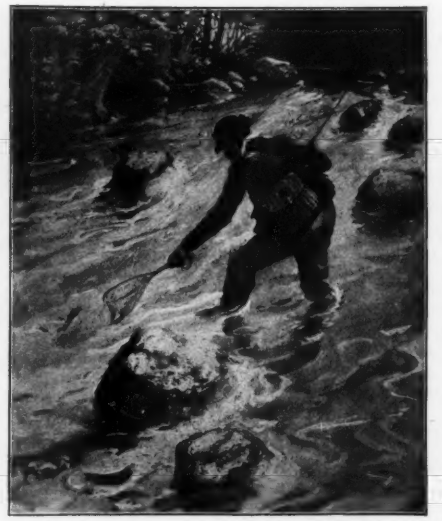

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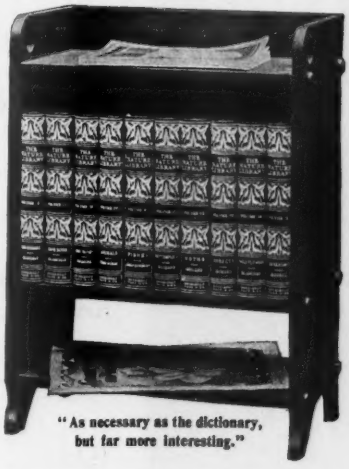

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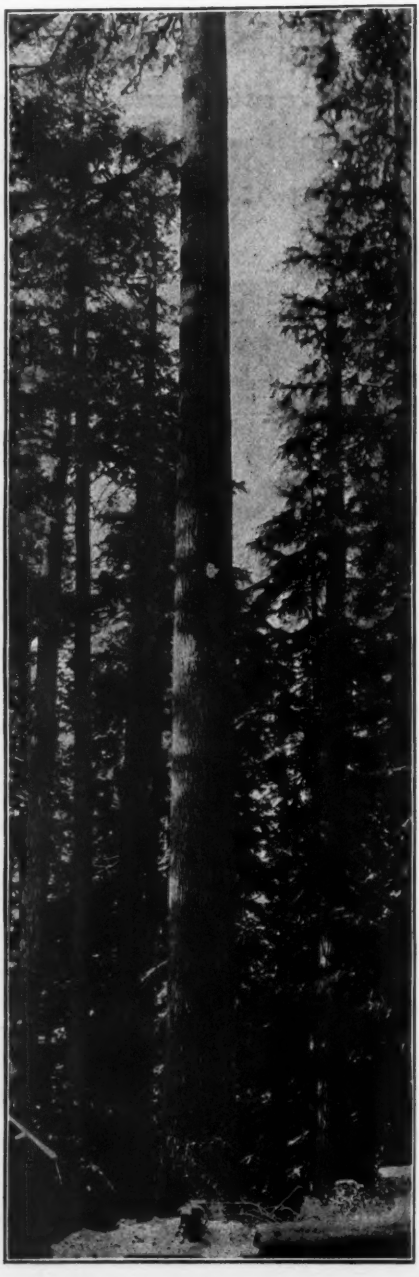

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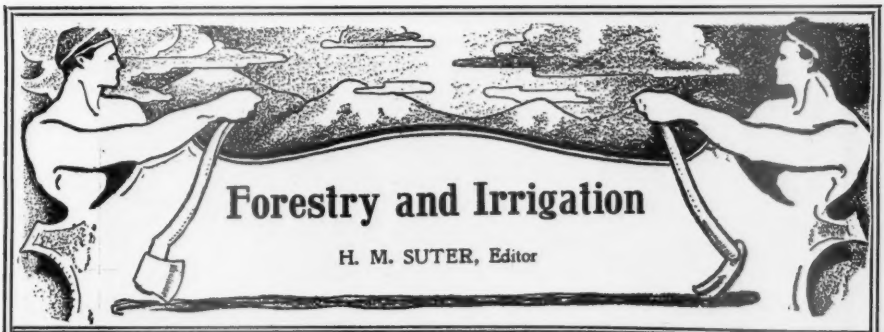

Forestry and Irrigation

H. M. SUTER, Editor

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VIEW OF LANDS TO BE IRRIGATED IN NEVADA BY THE FEDERAL GOVERNMENT.

Forestry and Irrigation.

VOL. X. AUGUST, 1904. No. 8.

NEWS AND NOTES.

Irrigation Congress. It has just been officially announced by the committee on arrangements that the Twelfth National Irrigation Congress will be held at El Paso, Texas, November 15–18. Further particulars of this interesting event are published on page 380 of this issue.

State Forestry in Massachusetts. Massachusetts now has a state forest service authorized by law. The law went into effect July 1, and the official to be known as the state forester was appointed by the governor. The law provides that the incumbent must be a trained forester with a technical education. It shall be his duty to promote the perpetuation, extension, and proper management of the forest lands of the state, both public and private. He shall also give a course of instruction to the students of the Massachusetts Agricultural College on the art and science of forestry. The salary of the state forester is $2,000 a year, and the appropriation for carrying on the work during the present year is $5,000.

Governor Bates has appointed to the position of state forester Mr. Alfred Akerman. Mr. Akerman is the son of former Attorney General Amos T. Akerman, of Cartersville, Georgia. He is a graduate of the University of Georgia, and later studied forestry at the Yale Forest School and at the University of Tubingen, Germany. He has served a year as assistant professor of forestry at the Yale Forest School, and has also been a field assistant in the Bureau of Forestry. Mr. Akerman is well equipped for his work, both from the standpoint of technical education and practical experience in forest work.

Constructing Engineer Examination. An examination for constructing engineer under the Reclamation Service was held by the Civil Service Commission April 1, 1904. The compensation offered was from $3,600 to $4,800 per annum. About 230 engineers entered papers for this position. These papers were examined and marked quite severely, the average marking being between 65 and 75 per cent. Out of the 230 papers 60 were given a rating higher than 70 per cent.

Appointments have been offered to the three men who stood highest on this list, namely, Thomas F. Richardson, of Clinton, Mass.; Chas. E. Wells, Clinton, Mass., and Alexander E Kastl, of Denver, Colo. This practically closes the matter, although the list of eligibles can under existing practice be utilized by various branches of the government service who may desire to select men from it for other positions.

Ontario Guards Against Fire. The Commissioner of Crown Lands has just issued a code of very strict regulations for the observance of all persons exploring, prospecting, hunting, or pleasure-seeking on the now extensive forest reserves of Ontario. They will be rigorously enforced, and are as follows:

"Every person entering on this reserve shall, when requested to do so by the superintendent or rangers, furnish his name, address, proposed duration of his stay, parts of reserve he intends to visit, and such other information as the superintendent or rangers may require.

"No person shall prospect for minerals in any forest reserve except by authority of a permit in that behalf issued by the Commissioner of Crown

Lands, for which a fee of $10 per year shall be charged.

"No person shall, except under the authority in writing of the Commissioner of Crown Lands, cut down, take the bark off, or otherwise injure any standing or growing timber in any forest reserve.

"No person shall be permitted to set out or start a fire for any other purposes than cooking or obtaining warmth, except by express permission of the Commissioner of Crown Lands.

"To start a fire for cooking or warmth observe the following precautions: Select a bare rock whereon to kindle such a fire, if possible; if no such rock is available, then select a site on which there is the smallest growth of vegetable matter, dead wood, branches, brushwood, or resinous trees; clear the place for the fire by removing all vegetable matter, dead trees, brushwood, branches, and dry leaves from the soil within a radius of 10 feet from the fire; exercise and observe every possible precaution to prevent such fire from spreading and carefully extinguish fire before quitting the place.

"Any person failing to comply with the provisions of the act for the protection of forests from fire, or of the forest reserve regulations, shall be subject to a fine of not exceeding $50 for each offense.

"All persons acting as guides to parties of tourists or others must produce a license, which may be procured by approved persons from the superintendent of reserves, or the chief fire ranger in charge of any reserve, on payment of the annual fee of $1.

"The superintendent may cancel the license of any guide upon being satisfied the holder has violated any of the provisions of the act to preserve the forest from fire, the act to create forest reserves, and the regulations thereunder, or the laws for the protection of fish and game.

"The fire rangers in a forest reserve are also game wardens, and authorized to arrest, without process, any violator of the game laws for an offense committed in his presence, and the said ranger shall with reasonable diligence cause him to be taken before any justice of the peace for trial."

Irrigated Farms in Nevada. About 250 farms lying in townships 18 and 19 north, ranges 28 and 29 east, in Nevada, are now open to homestead entry under the terms of the reclamation law of June 17, 1902. These farms are from 40 to 160 acres in area, and will be furnished with water from the government canals and reservoirs at a cost of $26 per acre, payable in ten annual installments.

The maps showing the location and extent of each of these farms are in the hands of the General Land Office, and entries can be made under the homestead act subject to the limitations of the law of June 17, 1902.

The land is to be given away to persons who will live upon it for five years and who will pay the cost of bringing water to the land, namely, $2.60 per acre for ten years. After that time the water-supply system becomes the property of the water users owning the lands.

Public Land Commission. Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, and F. H. Newell, Chief Engineer of the United States Reclamation Service, both members of the Public Lands Commission, recently left Washington on an extended trip through a number of the public-lands states. Their time on this trip will in a great measure be devoted to collecting information bearing on the various public-land problems. On August 3, 4, and 5 they attended the meeting of the National Live Stock Association and others interested in the public lands held at Denver. On August 7 they arrived at Boise, Idaho. Mr. Pinchot will spend some time in the vicinity of Boise, and will arrive in Spokane on the night of August 15.

Mr. Newell's program, meantime, is as follows: August 8, Boise, Idaho, public meeting; August 9, Ontario, Oregon, in connection with the Malheur irrigation project; August 10, Pendleton,

Oregon, to meet the Oregon State Commission for Revising Water Laws; August 11, at Walla Walla, Washington, to meet the Washington State Commission for Revising Water Laws; August 12, Walla Walla, Washington; August 13 and 14, at Pasco, Washington; August 15, reaches Spokane and meets Mr. Pinchot, traveling together during balance of the trip; August 16, they leave Spokane; August 17, at Wallace, Idaho; August 18, Missoula, Montana; August 19 and 20, Helena, Montana; August 21 and 22, Great Falls, Montana, and vicinity; August 23 and 24, Sun River, Montana; August 25, 26, 27, and 28, Marias River; August 29 and 30, Malta; August 31, at Buford, Montana; September 2, arrive at St. Paul, Minnesota; September 3, in St. Paul; September 4, in Chicago; September 5, Washington, D. C.

These dates are approximately correct, but subject to change.

Classification of Foresters. A new classification of technical grades in the Bureau of Forestry went into effect July 1. This change was made in order to provide a set of generic titles that would tell more clearly what its men are doing. The titles are more easily distinguished, are more dignified, and mean more to the men themselves.

The new grades, with the yearly salaries they carry, are given below:

Forester, $3,500.

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Assistant Forester, $2,100–$2,600.—Chiefs of divisions and men occupying positions of similar responsibility.

Forest Inspector, $1,800–$2,000.—Chiefs of the ranking sections of divisions and men in charge of independent lines of work of similar importance.

Assistant Forest Inspector, $1,500–$1,700.—Chiefs of sections of divisions, except of the ranking section, and men occupying positions of similar responsibility.

Forest Assistant, $900–$1,400.—Men who enter the Bureau through the examination for Forest Assistant and have not yet been given charge of independent lines of work.

Forest Agent, $700–$900.—Men without civil-service standing, in charge of subordinate lines of work.

Forest Student, $300.—Men whose service is temporary and educational in character and whose training in forestry is incomplete.

Promotions of Rangers. Mr. O. Chandler, third-class ranger in the San Bernardino Forest Reserve, has been promoted to second-class ranger.

Philip Begue and R. H. Hiatt, third-class rangers in the San Gabriel Reserve, have been promoted and are now second-class rangers.

Underground Waters of Louisiana. To no state in the Union has a copious supply of deep-well water been a greater boon than the State of Louisiana. The use of underground waters for the irrigation of rice fields has led to the sinking of an unusually large number of wells in the southern part of the state, especially in the region along the coast, where values in some localities have increased five to ten fold within the last ten years through the reclamation of the land by irrigation. Water-supply and Irrigation Paper No. 101 of the United States Geological Survey, entitled "The Underground Waters of Southern Louisiana," recently published, contains a great deal of information that may be of value to people interested in the industrial development of Louisiana. It was written by Prof. Gilbert Dennison Harris, of Cornell University, and Mr. M. L. Fuller, of the Survey, has added a discussion of the uses of the water for water supplies and for rice irrigation.

Professor Harris discusses the origin of artesian and deep-well waters in southern Louisiana. He presents facts showing that neither gulf waters nor river waters are the main sources of supply of the deep wells, and holds that the normal precipitation is entirely sufficient to account for the well supply.

The annual rainfall of about 55 inches is more than double the quantity necessary to irrigate the land if it were planted in rice. Much of this water is undoubtedly lost by flowing away in surface streams to the gulf or by leaching out into the gulf underground. Owing to the fact that the main local streams of southern Louisiana have never been gauged, the amount of water that reaches the sea, even by surface streams, is not yet known. Without proper hydrographic data, such as the United States Geological Survey is accumulating in many districts, it is impossible to even approximately estimate the extent to which the total amount of rainfall may be utilized here as deep-well water.

The topography and stratigraphy of southern Louisiana are discussed in considerable detail by Professor Harris, who shows how they modify the character and the condition of the water. The bulk of the paper consists of well statistics. Numerous wells throughout the various parishes are described and records are given, where possible, of their depths, the strata they penetrate, and their flows. The variation in flow and pressure-head shown by wells east of the Mississippi and by those west of that river is discussed. Professor Harris concludes with a chapter on well drilling and pumping.

In discussing the increased use of underground waters in southern Louisiana, Mr. Fuller speaks of them as sources of town and domestic, of farm, railroad, and manufacturing supplies. Extensive tables are given to show the extent and importance of the use of well and combined well and bayou systems for the irrigation of rice in Louisiana. The method in which the water is applied and the land farmed is also described.

Forester for Ontario. Dr. Judson F. Clark leaves the Bureau of Forestry during the present month to become Provincial Forester of Ontario, Canada, a position recently created by its government. He will organize a Division of Forestry in the Crown Lands Department. Dr. Clark is a graduate of the agricultural college at Guelph, Ontario, and later pursued graduate studies at Cornell University. Following this he was an instructor in the New York State College of Forestry up to the time of its discontinuance. Dr. Clark made an excellent record while in the Bureau of Forestry, and he goes to his new position highly recommended by its officials.

To Test Seeds. A circular recently issued by the U. S. Department of Agriculture should go a long way toward breaking up the traffic in bad seeds. The circular runs as follows:

"The act of Congress making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1905, contains the following:

"'The Secretary of Agriculture is hereby directed to obtain in the open market samples of seeds of grass, clover, or alfalfa, test the same, and if any such seeds are found to be adulterated or misbranded, or any seeds of Canada bluegrass (*Poa compressa*) are obtained under any other name than Canada bluegrass or *Poa compressa*, to publish the results of the tests, together with the names of the persons by whom the seeds were offered for sale.'

"Announcement is hereby made that the collection and testing of seeds as directed by this act will begin July 1, 1904.

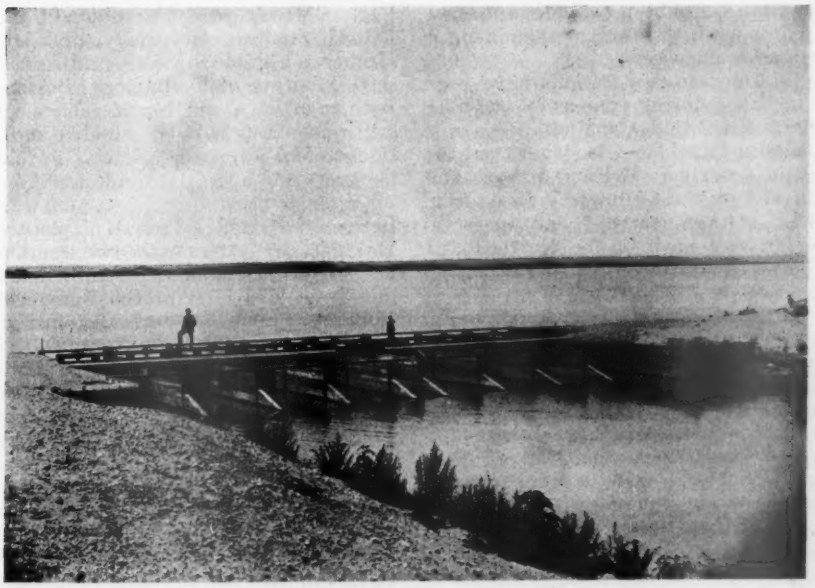
"JAMES WILSON,
"*Secretary.*"

Forest Fires. It is interesting to note how conspicuous is the absence of serious forest fires in several states which have enacted forest-fire laws and directed a rigid enforcement of the same. Realizing the import of the saying, "A stitch in time saves nine," several measures designed to prevent the occurrence of forest fires have been promulgated by the Ontario government, and especially are these regulations designed to safeguard Crown lands from damage by railroads. New York State wardens have been vigorous this season in the matter of prosecu-

tions for infringement of the state forest laws, and prompt action by state forest officials and forest-reserve rangers in several states have in many cases averted serious damage. Reports from the State of Washington indicate that forest fires are again prevalent, although not in the same territory as those chronicled in the July number of FORESTRY AND IRRIGATION. Four different fires were reported in Kings county on July 12, and it is reported that about 800 acres of fine timber were burned over. Damage was also done in the territory surrounding the Tulalip Indian Reservation. By far the most serious fires of the past month, however, have been in Newfoundland and British Columbia. The area of destruction in the interior of Newfoundland is stated to be greater than that affected by any previous conflagration. Notre Dame Junction, a lumber settlement, was all but consumed, and several lumbering firms have suffered extensive loss through destruction of their outfits and plants. Canadian newspapers place the loss in Newfoundland alone at $175,000, including loss incurred in the destruction of buildings, lumbering outfits, mills, and timberland. Nova Scotia and New Brunswick have been visited by numerous minor forest fires, owing to the favorable conditions of drouth and heat. On the other side of the Canadian domain serious damage has been done in the northern Saanich district of Vancouver Island, and in the mountains near Ladysmith. In the northeast of Wulffsohn Bay a fire of considerable magnitude is reported to have destroyed a large acreage of timberland.

A small fire engaged the attention of forest rangers near Prescott, Arizona, in the early half of July, and during the same period a serious fire was reported in the Huachua Mountains near Tombstone. Forest fires in this section are of a more serious aspect than the actual monetary value of the property destroyed implies, since their protection of the water supply is vital and the welfare of the country greatly dependent upon their influence.

California suffered losses in two localities—in the Yosemite, at the foot of Mount Starr King, and in Sierra



HEADGATE OF AN IRRIGATION CANAL ON THE NORTH PLATTE RIVER.

county, at the foot of Beckwith Peak. Forest fires have been prevalent in the district between Bayfield and Port Wing, in Wisconsin, practically the same territory which suffered in May. A widespread area of dry slashings offers a favorable opportunity for the fire to gain headway. A minor blaze near Escanaba, Michigan, created a scare among residents of that town as to the safety of outlying buildings, but no damage was done. The fires in the Mogollon Mountains of New Mexico, near Silver City, which, as stated in our June issue, were extinguished, broke out again during July.

Some loss was occasioned lumbermen in Maine by fires in scattered localities during the last week of June. The most serious of these occurred in Washington county, but through prompt action on the part of State Land Agent Ring serious damage was averted.

Stream Measurements. During the past two months the stream measurement work of the U. S. Reclamation Service, which was started in the early spring in the Western States, has been extended into new territory, which is being examined for irrigation purposes.

In Colorado new stations have been established during June as follows: La Plara River and Canal at Hesperus, Laramie Canal at Glendevey, on the Little Grizzly at Hebron, and on McIntyre Creek at Gleneyre. Aside from these stations, surveys and measurements were made on the North Platte and its tributaries in North Park, Colorado

In South Dakota new stations were established in connection with irrigation investigations at Seim on Grand River, on Indian Creek at Sanoma, and on Moreau River at Bixby.

In Idaho stations have been established on various canals in different portions of the state in order to determine the amount of water now being used for irrigation purposes.

Gaging stations were established in Utah during April, May, and June as follows: On Logan Creek at mouth of Canyon, Blacksmith Fork at Toll Gate, and also at Aqueduct Toll Gate, Jordan River at the pumping plant, Rock Creek at Duchesne, and on Logan River at Smithfield and Hyde Park.

Mr. E. C. Murphy, inspector of stream-gaging work of the U. S. Geological Survey, is now in the flooded district of Kansas making a careful study of the causes and extent of damage done by the recent floods in that state. During the past year Mr. Murphy has been making a careful study of previous floods in this and other sections of the United States, the results of which are contained in water-supply paper entitled "The Floods of 1903." This pamphlet will be ready for distribution in the near future. In connection with this subject several gaging stations have been established in the flood district of Kansas in order to determine the flood flow.

Hydrographic Aids. Albert I. Stiles and Leroy Hunter, hydrographic aids, have been assigned to the field force of Engineer George L. Swendsen, Salt Lake City, Utah. Mr. Stiles is a graduate of the Leland Stanford University, and Mr. Hunter is a graduate of the Massachusetts Institute of Technology, Boston. Both men have had considerable field experience and will be valuable additions to Mr. Swendsen's force.

In the Dakotas. The growth of planted trees in the two Dakotas will be studied this summer by a field force of the Bureau of Forestry. Some little work of inspection has previously been done in those states, but the possibilities of tree planting there are relatively unknown. The country is high and level for the most part, though broken here and there by canyons and small streams. There is less planted timber than in Nebraska. The plantations are usually the work of those who took up timber claims. Unlike much of the planting under the same law elsewhere, that done in the Dakotas was generally not perfunctory,

but careful and intelligent. Those who took up claims planted not only because it was necessary to make their titles good, but, since they felt the need of trees, they cultivated them properly, and they are now rewarded with valuable assets in their plantations. This growth will be carefully examined and measured as a basis for recommendations concerning scientific tree planting and management.

The field force this summer will be six experts, divided into two parties. They will begin in the southern part of South Dakota and work northward, covering both states east of the 99th meridian.

The topography and climate of the Dakotas make tree plantations essential to the highest development of the rich agricultural lands. The rainfall is less than in Nebraska or Kansas, but this is largely neutralized by the shorter crop seasons. The winds in summer are hot and dry, and of about the same velocity as in the two latter states. Because the rainfall is so small and the evaporation, accelerated by the high dry winds, is so great, trees in abundance are required to offset these disadvantages. Properly selected, and planted as shelterbelts and windbreaks, trees will greatly increase the yield from all crops by cutting down the force of the wind and conserving moisture.

The creation of woodlots is one result of tree planting that should specially appeal to the residents of the Dakotas. The long and bitterly cold winters necessitate the use of an enormous amount of fuel. This fuel can be grown within a few hundred yards of the house, far more cheaply than coal or wood can be delivered by the railroads. The woodlot will not only furnish fuel, but also, if the trees have been properly chosen, all fence posts and general repair material needed.

Woodlots need not be planted as a separate venture. They can be grown in connection with and partly as the result of the establishment of shelterbelts. The wider these are made, to a certain limit, and the more thoroughly they are extended around the farm, the greater the advantage in crop protection and the larger the annual cut of wood obtainable.

The first object of the Bureau of Forestry in its work in the Dakotas is to ascertain if the trees now growing there are the species that can be most profitably planted. The study will also cover the methods and cost of the tree planting that has been done, with the expectation of offering suggestions for improving those methods and lessening the cost. The results of this work can not fail to be decidedly advantageous to the farmers of those states, who, it is to be hoped, will further the work by offering the field parties all the information and assistance in their power to give.

Tree Planting in Illinois. The Bureau of Forestry will this summer pursue in Illinois a study from which it is expected material advantage will inure to the vast agricultural interests of that state. Planted timber will be made the subject of careful examination to determine what kinds of trees make the most rapid growth and are most valuable commercially and for use as windbreaks under the prevailing conditions of soil, moisture, and cultivation. The topography of Illinois is such that a forest cover is not usually needed to protect the soil from erosion. The land for the most part is rolling or level prairie, rich and admirably suited for agriculture. A farmer reaping large harvests from his lands naturally will not consider putting those lands to a less profitable use, but experiments have proved that shelterbelts, in protecting the lands from wind, influence a larger crop yield.

Shelterbelts are invaluable in protecting crops from the damage frequently resulting from the full force of destructive winds, but possibly their chief value is in conserving the moisture so absolutely essential to crop growth. Wind is a strong ally of evaporation. It is established that as the velocity of the wind increases, evaporation is very rapidly augmented. Shelterbelts, in opposing the wind, effectively retard evaporation, and thereby save to growing

crops the soil moisture necessary to keep them thrifty during dry, windy times. These facts are especially pertinent in a treeless, level agricultural country, where the wind has an unobstructed sweep for miles and gets constantly drier in its course. The strips of land that farmers in Illinois might divert from agriculture in creating shelterbelts would be put to better use than if continued in crops, because the remainder of the land would be so much benefited by the change. Nor is protection from the effects of wind the only advantage that would be secured from the creation of shelterbelts. If composed of suitable kinds of trees, shelterbelts can be made to answer the purpose of valuable woodlots, furnishing all the fuel, fence posts, and farm-repair material the farmer may need. The two uses will admirably go hand in hand, and between them will materially improve the value of the land and the comfort of the farmer.

To promote this end the Bureau of Forestry has assigned to Illinois for this summer a field party of five experts, under the supervision of Mr. R. S. Kellogg. They will study both native and planted trees to gain a full understanding of the rate of growth and reproductive powers of the trees which are the most valuable for the state. Data will be collected relative to the cost and methods of planting and the time required to grow timber to the size required for usefulness. When the study is completed a full report on the subject will be published.

Geographic Congress. The Eighth International Geographic Congress will be held in this country next September. The Committee of Arrangements has invited all bureaus of the government that are concerned with geographic work to appoint representatives at this Congress.

The subjects for treatment and discussion at this Congress may be classified as follows: Physical geography, including geomorphology, meteorology, hydrology, etc.; mathematical geography, including geodesy and geophysics; biogeography, including botany and zoölogy in their geographic aspects; anthropogeography, including ethnology; descriptive geography, including explorations and surveys; geographic technology, including cartography, bibliography, etc.; commercial and industrial geography; history of geography; and geographic education.

A special opportunity will be afforded for the discussion of methods of surveying and map-making and for the comparison of these methods as pursued in other countries with the work of the federal and state surveys maintained in this country.

The National Geographic Society of Washington, D. C., as the organization responsible for the management of the sessions in the United States, will play the part of host and welcome the Congress, on September 8, to its new home, the Hubbard Memorial Hall, on Sixteenth street, in Washington. Sessions will be held there on September 9 and 10. Leaving Washington on the 12th, the members, associates, and guests of the Congress will be entertained during that day by the Geographical Society of Philadelphia, and on the 13th, 14th, and 15th by the American Geographical Society in New York, where scientific sessions will be held. On the 16th they will have the opportunity of visiting Niagara Falls, and on the 17th will be entertained by the Geographic Society of Chicago. On the 19th and 20th they will be invited to participate in the International Congress of Arts and Science connected with the World's Fair, in St. Louis. If there is sufficient demand, a Far-West excursion will be provided from St. Louis to the city of Mexico, Sante Fé, the Grand Canyon of the Colorado, San Francisco, and the Golden Gate, with a return by any preferred route through the Rocky Mountains and the interior plains to eastern ports.

San Francisco Reserve. A study of forestry seems to be especially esteemed in countries where there are no longer forests to study. In furtherance of this work, the United States Geological Survey has just

published Professional Paper No. 22, which bears the title "Forest Conditions in the San Francisco Mountains Forest Reserve, Arizona." This paper embodies the results of investigations made during 1901 and 1902 by John B. Leiberg, Theodore F. Rixon, and Arthur Dodwell, and is prefaced by an introduction written by F. G. Plummer, which is particularly interesting.

The San Francisco Mountains Forest Reserve comprises portions of the broad summit and slopes of an elevated tract of land in north-central Arizona, which includes the southern part of the Colorado Plateau. The northern part of the area is dotted by several hundred volcanic cones and the southern part is gashed by numerous deep canyons. The altitude of the region ranges from 3,500 feet at Oak Creek, in its southwestern portion, to 12,794 feet at the summit of San Francisco Peak.

Among the coniferous trees in the reserve the western yellow pine constitutes over 99 per cent of the total forest. The aspen takes first rank among the broad-leafed species, but has a close competitor in the oak. The chief lumber tree at present is the western yellow pine, which is extensively cut and furnishes all of the mill timber sawed, used in, and exported from the region. Its average total height is 85 feet, with about 10 feet of clear trunk. The diameter averages 18 inches, which corresponds to an age of 180 years. In the 812,500 acres of forest area examined, 2,743,558,000 feet, B. M., of standing timber were found, which gives an average of only 3,377 feet, B. M., per acre. It is evident that the western yellow-pine stands, even where entirely untouched by the ax, do not carry an everage crop of more than 40 per cent of the timber they are capable of producing. This condition is chiefly attributable to the numerous fires which have swept over the region within the last two hundred years, destroying seedling and sapling growth.

The chief agencies through which the forests in the reserve suffer destruction are cutting, grazing, and fire. Logging operations have been carried on in most of the central forested areas that are tributary to railroads. The forest has been culled or cut from 148,845 acres. The timber cut on these tracts has been converted into tie, stull, or round mining timber and saw-logs.

Grazing, especially sheep herding, is ruinous to the seedling growth of a young forest. Sheep are especially fond of the young aspen, which spring up as the first restockage on the non-forested park lands at the base and on the slopes of San Francisco Mountains. It was found that the destruction of seedlings on any particular tract of land ranged from 50 per cent to total after a single passage over such ground by 2,000 head of sheep.

Fires have been of frequent occurrence in all portions of the reserve. The badly burned areas, on which the destruction has been 60 per cent or more, aggregate 6,790 acres. The origin of fires in recent years may, in part, be ascribed to the carelessness of sheep herders, in part, to sparks from engines on the Atchison, Topeka, and Santa Fé Railroad, but by far the largest number of fires are due to lightning, and this cause has, of course, always operated. Sections exist on which 50 per cent of the mature western yellow pine has been either wholly or in part killed by lightning strokes.

Among other interesting questions considered in this paper are the low reproductive ratioof the yellow pine, the influence of the forest on run-off, the grazing value of the reserve, and the effects of sheep herding on the forest floor. The bulk of the paper is devoted to detailed descriptions of the areas, by range and township, that make up the reserve.

Hydrology in Western States.

Mr. N. H. Darton, geologist in charge of the western section of hydrology, United States Geological Survey, left for the field June 20, to spend five months in supervising the work of assistants in various portions of the West. He will make an examination of the western slope of the Bighorn Mountains, and will spend several weeks in the region lying north of the Black Hills in order to obtain material required to complete a report

on the "Geology and Underground Waters of the Region North of the Black Hills." Later in the season further work will be done in the Arkansas Valley, in southeastern Colorado, to complete the data for a report on that important artesian district. Visits will be made to a number of dam-sites in various portions of the West for the purpose of ascertaining the geological conditions in each locality. Investigations of special problems of underground waters will be made in Nevada, Idaho, Arizona, and New Mexico.

Investigations of the underground water resources and geology of southern California will continue under the direction of Mr. C. W. Mendenhall. Much of his attention during the early part of the season will be devoted to the preparation of reports and maps for publication.

Mr. C. E. Siebenthal, assistant geologist, has been directed to continue his examination of the San Luis artesian basin, Colorado. When that work is completed, he will investigate the prospects for artesian wells in the Uncompahgre Valley, and at the end of the season will examine the prospects for obtaining deep-seated waters in the area at Denver, which has not so far been fully explored by deep wells.

Mr. C. A. Fisher will continue his studies of the geology and underground water resources of the Bighorn basin, in northern Wyoming. He will also examine the coal deposits and determine the prospects for oil and gas in that region.

Mr. G. B. Richardson has been assigned to a study of artesian problems in the eastern part of the Salt Lake basin, in Utah. In this region numerous wells are found, but the underground waters present many variations in conditions of occurrence. During the first part of the season Mr. Richardson will finish his work on the geology and waters of El Paso, Texas, with the view of completing a geologic folio on the El Paso quadrangle.

Mr. Willis T. Lee will make a reconnaissance of Owens Valley, California, where it is believed the underground water conditions are similar to those in some of the valleys in southwestern California and south-central Arizona. Later in the season Mr. Lee will continue his observations in the Gila Valley, Arizona, with a view to ascertaining the extent of the area in which underground waters are available, their volume, and the best means of utilizing them for irrigation.

Hydrographic Work in East. The hydrographic work in the New England States, which has been organized and carried on under the direction of Mr. N. C. Grover, of the United States Geological Survey, was transferred to H. K. Barrows on July 1. The following number of stations are being maintained in this district: Maine, 18; New Hampshire, 12; Vermont, 3; Massachusetts, 3; Rhode Island, 1, and Connecticut, 1.

A systematic study is being made of the developed and undeveloped water power in Massachusetts, Connecticut, and Rhode Island, and other gaging stations will be established in these states at an early date.

In Maine profiles are being made of the lower portions of the Penobscot and Kennebec rivers. In connection with these profiles surveys are being made of those portions of the rivers which are well adapted to the purposes of the Survey.

Mr. N. C. Grover, who for the past two years has carried on the hydrographic work in New England, has been transferred to the Washington office, where he will direct similar work in New Jersey, Pennsylvania, Maryland, Virginia, and West Virginia. A careful reconnaissance is being made in these states, and the work will be extended into new localities during the coming season.

In the Southern States Mr. M. R. Hall is maintaining 2 stations in Alabama, 24 in Georgia, 3 in Mississippi, 5 in South Carolina, 12 in North Carolina, and 10 in Tennessee. Of these stations several have been established during the present season, and special efforts are being made to investigate localities of undeveloped water power.

MR. THOMAS H. MEANS,

ENGINEER OF SOILS, U. S. RECLAMATION SERVICE.

IN this issue we print an article on "The Use of Alkaline and Saline Waters," by Thomas H. Means, Engineer of Soils, United States Reclamation Service.

Mr. Means is particularly fitted for this work, through long and careful training in the Bureau of Soils and through a close study of alkali conditions in this country, in Europe, in northern Africa throughout Algeria, the Sahara desert, and in Egypt. What makes his work of particular value is that it has been carried on in connection with irrigation problems, in which Mr. Means is expert, as those who read his articles on the Nile dams in FORESTRY AND IRRIGATION will readily understand.

Thomas H. Means was born at Waterford, Virginia, November 15, 1875, of good old Quaker stock. He received his education in the public schools of Washington and graduated a C. E. from Columbian University, besides obtaining degrees for work in chemistry and physics. He served in the Bureau of Soils for ten years before joining the Reclamation Service this spring, becoming head of the United States Soils Surveys, and establishing a reputation as the foremost authority on alkali problems in the country. His work from now on in connection with the reclamation service will be of signal value in determining the steps for reclaiming so much of the saline lands of our West, and his decisions concerning alkali, with the remedies he may propose to remove adverse conditions, will be of immense value.

THE USE OF ALKALINE AND SALINE WATERS FOR IRRIGATION.

BY

THOMAS H. MEANS,

ENGINEER OF SOILS, U. S. RECLAMATION SERVICE.

THE greater part of the water easily available for irrigation in the arid regions of the United States has been appropriated, and in many cases appropriation has gone so far beyond the easily available as to require extensive and costly irrigation works to bring the water to the land. As time goes on, the scarcity of water becomes more evident, and we are now confronted by large areas of excellent land, lying in a position very favorable for irrigation, with little or no water in the streams for the accomplishment of this irrigation.

In the effort to extend the area of irrigated land so as to include these unoccupied tracts, sources of water more or less contaminated with salt and alkali have been developed, and the application of these waters to the land has produced a new set of conditions worthy of our careful consideration. The fact that water contains much or little soluble matter seldom enters into the calculations of the farmer or engineer, and serious mistakes, involving heavy loss, have been made by the use of water containing excess of salt or alkali—mistakes often the result of lack of knowledge concerning the effect of salt and alkali upon plant growth. Cases, however, are on record where water has been condemned by chemists, but its use persisted in by canal companies or individuals to their serious loss. Again, on the other hand, well-meaning chemists have been prone to condemn sources of water as detrimental to plant growth, and in that way have seriously hampered the development of agriculture, when by proper methods of cultivation and irrigation this water might be used successfully and profitably. A number of cases have recently come to notice where pumping plants have been closed down by the advice of chemists, on account of the salt and alkali in the water, when such waters could be used a thousand years without detriment to the soil or growing plants if the farmer understood the proper methods of handling alkali waters, and in southern California and Arizona orange and lemon trees have been killed by the use of a slightly alkaline water when, by a very simple change in methods of irrigation, the trees could have been made to flourish. All this points to the fact that information upon the best methods of using saline and alkali waters is needed.

Chemists have made serious attempts to define the limits of the amount of various chemical salts allowable in a water to be used for irrigation. At the present time the statements seen in print are greatly at variance. Many statements are made largely from the result of laboratory studies, while others are made from studies over a very limited field. In work of this sort it is very difficult to determine from laboratory investigations how much alkali a plant will stand, and it is only by very wide observation of field conditions where alkali waters are in use that definite information can be gathered as to the limits of endurance of ordinary crops. For example, water is used on large areas of land in New Mexico and Arizona, and has been used successfully from ten to twenty years, which would be regarded with suspicion or condemned in California.

Studies carried on in the Department of Agriculture, Bureau of Soils, over the entire western irrigated area, led to the publication in 1899 of the following statement: "Five hundred parts of soluble matter may be taken as the extreme limit of endurance for plants, while 250 or 300 parts mark the danger point, at which the results of the use of the water are very uncertain."

At this same time other writers on the subject place the limit at 30 parts sodium chloride and from 173 to 300 parts of the less harmful salts per 100,000 of water. Thus it will be seen

that quite a margin existed between the limits set by the two authorities. Since then, in 1903, the writer published a short account of the use of saline waters in Algeria, where water with as high as 816 parts soluble matter was in successful use.

The interest in this subject warrants a more extended statement of the subject than has been made. Inquiries have been received from many quarters for more explicit information, and to answer these this article has been written.

In considering the fitness of a water for irrigation purposes there are a number of factors to be taken into consideration besides the amount and chemical character of the salts which it holds in solution. The most important of these factors are: the soil to be irrigated, its texture, depth, and amount of alkali salts present in it; the abundance of the water for irrigation, and the character of crops to be raised.

Certain salts, such as those of iron or copper, are very poisonous to plants, and very small quantities in water are sufficient to condemn such a water as dangerous or unfit for irrigation. Fortunately, the occurrence of such waters is rare, but waters pumped from mines or from waste, from mills and smelting works, is sometimes dangerous, and where trouble is experienced with water in mining districts where mills or mines are upstream, then metals should be looked for in the water.

LIST OF SALTS.

The salts most commonly found, however, are sodium chloride, or common salt; sodium sulphate, or Glaubers salt; sodium bicarbonate, or baking soda; sodium carbonate, or washing soda; magnesium sulphate, or Epsom salts; magnesium chloride, or bittern; calcium carbonate, or limestone, and calcium sulphate, or gypsum. This, though apparently a formidable list of salts, is much simplified when considered as regards the effect upon plant growth. The two salts of calcium are beneficial to plant growth, and are so slightly soluble that they can not exist in a water in harmful quantity, so need not be considered in an analysis. The remainder of the salts are divided into two groups—black alkali, or sodium carbonate, and white alkali, or the other salts.

Of all the salts the sodium carbonate, or black alkali, is by far the most harmful. In ordinary irrigation practice plants will stand at least five times as much white alkali as black, and in irrigation waters the same relation will hold.

Of the white alkali salts, sodium chloride is generally the most destructive, its effect being approximately twice as harmful to vegetation as the rest of the salts. Of the other salts little can be said, except that they are the least harmful of those ordinarily found in irrigation waters, and that there is very little difference in their relative poisonous effect on plants.

Sodium carbonate has two effects on growing plants in the soil—first, the ordinary effect of any material in solution, whether that be an osmotic effect upon the cells of the roots (or whether it be due to the action of irons on these cells is a question still in dispute), and, second, a caustic action upon the vegetable tissues of the growing plant. This caustic action corrodes and dissolves the delicate portions of the plant below ground, and frequently immediately at the surface girdles the plant. By the application of gypsum or land plaster to a soil containing black alkali this caustic nature is neutralized and a chemical reaction takes place between the gypsum and sodium carbonate, forming one of the less harmful white alkali salts, sodium sulphate, and a relatively insoluble compound, calcium carbonate. This reaction can be utilized in the treatment of soils containing black alkali, but the high price of gypsum has not permitted this to be carried on to any great extent. Ordinarily under-drainage is cheaper. The same reaction can be utilized where waters containing sodium carbonate are used.

It has been recommended that water containing sodium carbonate in solution should be run through cribs filled with crushed gypsum. The reaction is, however, exceedingly slow. It would generally require several hours or days' contact to thoroughly neutralize the alkalinity. For this reason it is generally better, where black alkali waters are to

be used in irrigation, and where the black alkali remains in the soil, to apply the gypsum to the soil direct.

Sodium carbonate, or black alkali water, in contact with air, which always contains carbonic acid gas, undergoes a change, and is in part converted into sodium bicarbonate by the absorption of the gas. In this way the alkaline character of water is sometimes much ameliorated, for sodium bicarbonate is neutral in reaction, and from all available information is no more harmful than the other white alkali salts. In equilibrium with atmospheric air, there is a definite relation between the relative amount of carbonate and bicarbonate found, the percentage of the latter increasing with the amount of carbonic acid gas present. Thus when water containing sodium carbonate is applied to a soil, a certain definite portion is converted into the bicarbonate, a greater portion than would be converted in normal air, for carbonic acid gas is more abundant in soil air than in the air above the soil.

Whenever water containing sodium carbonate is used, every facility for under-drainage should be supplied to remove the excess of the salt, and should the black alkali begin to accumulate to the detriment of the growing crops, gypsum in a powdered form should be applied to the soil.

The following table shows the amount of sodium carbonate added to the soil in an acre foot of water containing a given amount of that salt, and the number of pounds of gypsum needed to neutralize all of the sodium carbonate. Part of the sodium carbonate may be changed to the bicarbonate and another part may be drained away, so that the figures for gypsum represent the maximum amount ever required, and in practice some smaller amount may serve.

Parts sodium carbonate per 100,000.	Pounds sodium carbonate in 1 acre foot of water.	Pounds of gypsum needed to neutralize the sodium carbonate.
5	136	221
10	272	441
15	408	662
20	540	880
25	680	1,100
30	820	1,320
35	960	1,540
40	1,090	1,760

The cost of gypsum varies so much that it is difficult to give the cost of the above applications. Ground gypsum or land plaster for agricultural uses should not cost much more than $2 per ton. The average price varies from $2 to $3 per ton.

At these prices, if it were necessary to add the maximum amounts given above, the use of water of higher concentration would be very expensive; but it is thought that it will never be necessary to add but a third or half of this amount in practice, and less if the under-drainage is good.

Sodium bicarbonate is very frequently found in irrigation waters. In itself it is no more harmful than the other neutral salts. Evaporation of the water containing it, causes a portion of the bicarbonate to revert to the carbonate, and therefore waters containing sodium bicarbonate should be held open to suspicion, just as are waters containing the normal sodium carbonate. Where the water contains less than 100 parts sodium bicarbonate per 100,000, the amount of sodium carbonate formed under natural conditions will never amount to more than 20 per cent of the whole. The danger is in allowing such water to concentrate on the field, for the percentage of sodium carbonate possible increases with the concentration, and in water containing 300 parts, as much as 40 per cent of it may revert to the carbonate. For this reason the dangers from surface evaporation of waters containing sodium carbonate and bicarbonate are greater than in other waters, for beside the actual concentration, which in itself is harmful, there is brought about by the concentration the dangerous change to black alkali. Surface cultivation and under-drainage are therefore all the more desirable. So far as our information goes, water containing more than 50 parts of sodium carbonate per 100,000 should not be used permanently for irrigation purposes. If the land to be irrigated contains gypsum, as arid lands usually do, a larger per cent of sodium carbonate is allowable; and, again, if gypsum be easily available for agricultural purposes, or is on sale at a reasonable price—that is, not exceeding

two or three dollars per ton—greater concentrations may be allowed.

The ordinary method of chemical analysis of irrigation waters is certainly greatly at fault, for an analysis usually shows all the sodium carbonate and bicarbonate as sodium carbonate alone. This is generally determined by evaporating the water to dryness, which decomposes the sodium bicarbonate and leaves only the carbonate. Every 100 parts of sodium bicarbonate will by this method give 62 parts sodium carbonate, whereas, as has been shown, the reaction within the soil is ordinarily in the opposite direction, the tendency being toward the decrease of the sodium carbonate and the corresponding increase of the bicarbonate.

Of the white alkali salts, much larger amounts are allowable in water. The waters of the Pecos Valley in New Mexico average over 300 parts of soluble matter per 100,000 parts of water, and where this water has been intelligently used, the soils have remained fertile after fifteen years of irrigation. This water contains about 152 parts of salts, easily soluble, and likely to accumulate in the soil. In the Salt River Valley of Arizona the waters of the Salt River vary from 70 to 140 parts soluble matter per 100,000, containing from 40 to 100 parts sodium chloride, and have been in use for thirty years upon soils varying from loose sands to heavy clay and adobe, and where care has been exercised in the use of such waters, no trouble has been experienced from the rise of alkali.

The waters of the Buckeye Canal, taken from the Gila River about 20 miles below Phœnix, Arizona, carry about 200 parts of soluble matter, of which about 130 are sodium chloride. This water is used upon light and, in some cases, fairly heavy soils, and where carefully handled has not resulted in the accumulation of alkali in the soil.

During the summer of 1902 it was the writer's good fortune to visit some of the oases of the Sahara Desert in eastern Algeria. In these oases, artesian waters carrying very large quantities of soluble matter are successfully used for irrigation purposes. Waters carrying as high as 810 parts per 100,000 parts of water were used in growing vegetables, while a number of wells carrying over 600 parts were in daily use, some of them carrying over 300 parts of sodium chloride alone. This water was used for the growing of fruit trees and vegetables, many of which are grown in our own country and are not considered especially resistant to alkali salt.

These amounts of salt in irrigation water are higher than those in common use in America, and it should certainly be encouraging to our engineers and farmers who, in developing underground water supplies, are constantly in dread of damaging their land by alkali.

Water containing 1,036 parts soluble matter was found too strong for permanent irrigation in Algeria, although there are places in Tripoli where sea water containing 3,500 parts of soluble matter is used occasionally for irrigating certain crops (date palms).

It should be remembered that the limit of endurance for most cultivated plants, in a water solution, is about 1 per cent, or 1,000 parts soluble matter per 100,000 parts water, and if every effort is made by the user of alkali waters to keep the concentration of his soil solution down to or below this limit there need to be no fear from alkali. It will be readily seen that every condition which favors the concentration of the water in the soil cuts down the limit allowable in the irrigation water, and, on the other hand, every condition which favors a ready flow of water through the soil and a low evaporation of water from the surface of the soil helps toward making it possible to use alkali waters in irrigation. To this end several methods of procedure offer.

It should be understood that the first requisite of any land under irrigation is good under-drainage. Where this is attended to or naturally present, frequent irrigation offers the simplest solution, for by this means the soil solution is kept dilute, and the excess of soluble matter which would accumulate after the evaporation of the water is washed down into the subsoil and into the drains. In Algeria, where the air and soil are intensely warm (when visited

by the writer the temperature in the shade reached 127° F.), the water is applied every two or three days during the summer. The soil was very light, and these frequent applications soon drained away. Where heavier soils are found, such frequent irrigation is by no means necessary or advisable, but a good watering once in ten days will be found sufficient to carry away all excess of accumulated salt.

In using saline or alkaline waters furrow irrigation is not advisable. All of the land should be covered, if not at every irrigation, at least occasionally, so there will be no high places on which the alkali can creep.

Where fresh water or water containing little or no alkali is available during a part of the year, occasion should be taken of this opportunity to use water plentifully, so that the accumulations of alkali can be washed out of the soil and a store of fresh water left in it. Flood waters from western streams are generally better than the normal or low-water flow. This is not always the case, however, particularly in the first flood which follows a dry period, for such floods sweep down the stream the alkali crusts which have formed, and often carry in solution large quantities of soluble matter.

Another method for the utilization of bad water has been suggested, and that is the growing of plants resistant to alkali. Date palms, pomegranates, pears, sugar beets, barley, sorghum, and asparagus are all more or less resistant and offer something in favor, over more tender species, to the farmer who must handle saline or alkaline water

AN OBJECT LESSON IN REFORESTATION.

HOW BARREN WASTES HAVE BEEN RECLAIMED IN FRANCE—NEARLY 700,000 ACRES OF CULTIVATED FORESTS NOW GROWING IN FRANCE—HOW TO SAVE THE SAND DUNES OF OUR COAST COUNTRY.

BY

ALBION W. TOURGEE,

U. S. CONSUL AT BORDEAUX, FRANCE.

THE growth of the maritime pine in the Landes and adjoining departments undoubtedly marks the most remarkable achievement ever wrought by human agency in the modification of natural conditions of soil and climate for the benefit of mankind. It is a marvelous demonstration not only of the practicability, but also of the almost boundless beneficence of reforestation. It demonstrates the fact that while human recklessness has swept forest and verdure from so vast an area of the Old World and the New human skill and care are able to reclaim the most barren and desolate regions with a growth which not only stays the advance of devastation, but reëstablishes in its place the most healthful, agreeable, and profitable conditions.

At the beginning of the nineteenth century the region between the Gironde and the Pyrenees, excepting a narrow belt which skirted the southern bank of the river, extending inward from 50 to 100 miles, was not only one of the most barren in the world, but apparently almost hopeless of reclamation. For 100 miles along the shore of the Bay of Biscay there stretched a threatening array of gray sand dunes which year by year pursued their irresistible march toward the heart of the most productive land in Europe at a rate varying from 1 to 200 feet a year. One after another great waves of sand, moved by the restless winds that swept across the Atlantic, continued their unceasing march across the fair plains of southern France, burying all before them—fields,

meadows, vineyards, houses, churches, even villages—leaving behind them only gray billows, to which clung bunches of bracken, a few starved bushes of scrub oak, and thickets of white and purple gorse, fighting stubbornly for a hold upon the shifting sands, with here and there some straggling groups of pines, the protesting remains of a great forest which wind and sand and fire and water had spared.

On the seaward side the great furrows, lying one within the other, were bare and gray. The western winds lifted the light sands (baring the roots of trees upon the seaward slopes) and dropped them just beyond the crest to drown and smother the shrubs which struggled up the leeward side. Here and there in favorable locations a few scattered pines marked the location of the ancient forests to which the Greeks and the Romans, perhaps even the Phœnicians, came for timber and pitch and left their names on the shore to mark the limits of forgotten commerce. They brought with them not only reckless greed, but still more reckless flame, which, coöperating with the steady western winds and the sand thrown up by the restless waves, ate away the forest and left only the shifting dunes—great sand billows that crept on inch by inch and year by year, entombing more of the bright-blossomed bruyeres and genets, no matter how bravely they fought for existence, leaving behind them only dry roots, which the "forestiers" gathered for their hearths. Wherever the foot of the sand dune rested, there was hopeless blight. A little wiry grass grew in the shadow of the heather and gorse, on which the sheep browsed, under the eyes of the solemn-faced shepherds perched on stilts and knitting as they watched. On and on crept the phalanx of the terrible dunes, slowly but surely blighting all in their path, not only creating a desert, but destroying hope. As long as the winds blew from the west the dunes marched to the east; the desert fires ravaged the intervening spaces; the flocks grew fewer, the desolation more extreme. In the heart of sunny France a desert was established, ever increasing in extent and threatening to stretch

FOREST OF MARITIME PINE ON THE DUNES IN GASCONY. THE WHITE SAND IN THE FOREGROUND IS THE EDGE OF A FIRE LANE.

across its fairest fields the aridness of the Sahara.

In the first year of the nineteenth century one of the sons of the doomed region had an idea. It was a simple one, but the times and circumstances were ripe for its adoption. It was that if the seeds of the maritime pine were gathered, sprouted carefully, and the young trees planted in advantageous positions, where the moving sands would not overwhelm them until their tough roots had taken a firm hold, their wiry leaves, which loved the briny spume, would offer no resistance to the wind, and, falling about their roots, would give shelter and nutriment until a forest grew which would hold the sands in check and save the threatened interior from desolation.

The idea was brought to the attention of Napoleon, in whose hands was not only the present, but the future, of France. He saw not only the danger, but the way to safety. His vision penetrated the centuries, and he saw the march of the deadly dunes arrested and the desert they had already created made to blossom like the rose. A century has passed and the statue of Bremontier looks down one of the great furrows which lie between the dunes he showed how to conquer and restore to verdant prosperity. Napoleon has added another laurel to that fame which makes his name almost a forbidden one to the peoples whom he forged into a nation of unique and marvelous solidarity. The greatest of all his victories is that by which the ever-increasing legions of the maritime pine are mustered along the coast from the mouth of the Loire to the Pyrenees to shelter the sunny plains from the assault of the sand-laden waves of the Atlantic and convert impending evil into an economic blessing. Today the dark squadrons of the maritime pine are posted on thousands of sandy slopes, faithful guardians in the shelter of which the vineyards and wheat fields rest secure. The gray dunes which were sweeping over the land have become serried fortresses, which shelter civilization and prosperity. Here, again, man has pitted himself against the destructive forces of nature and won, making the winds and waves his servants for the renovation of past

NATIVES OF THE FRENCH LANDES. MOST OF THE TERRITORY SHOWN IS NOW COVERED WITH PINE TREES.

A DUNE IN PROCESS OF FORMATION ON THE NEW JERSEY COAST.

evils and the establishment of future benefits. Lumber, firewood, resin, turpentine, and all the by-products of resinous distillation are now produced in such abundance here as not only to prevent the need of importation, but to make southwest France a considerable and profitable exporter of the same. Not only the finest lumber for domestic uses is produced, but railway ties, telegraph poles, fence and vineyard posts, and millions of the pit props which sustain the roofs of English collieries come from the eastern shore of the Gulf of Gascony, the ships that bring Welsh coals carrying back the supports which make the mining of coal possible.

SAND DUNES OF THE UNITED STATES.

The United States, which in the beginning of the nineteenth century had the monopoly of naval stores and the resinous products for which civilization makes increasing demand, now finds a rival in the maritime pine of the dunes which were then worse than barren, and it is today a considerable importer through the port of Bordeaux of the finer products of resinous distillation. While we have wasted our abundance by reckless destruction of our forests, France, by intelligent conservation of hers through reforestation of her dunes, has made them productive and profitable. The one has developed wealth from barrenness and the other as rapidly evolved barrenness from lavish abundance. Dunes like those which a century ago threatened the prosperity of France are today making serious inroads on our Atlantic and Pacific seaboards. While France made enlightened appeal to the maritime pine and its associated growths to save her from threatened desolation, we have refused protection to the much richer long-leafed pines, which asked only opportunify to continue to pour wealth and favor upon our. southern slopes. Will the conditions of a century ago be

reversed at the end of a century to come? From Maine to Florida and from Mexico to British Columbia the causes which made the dunes of Gascony instruments of devastation are at work almost without attempt on our part to limit their operation, while across the ocean, encouraged by the success of a wonderful experiment, the French are trying to find a way to change the character of still greater areas by reforestation of the Sahara, not by means of the maritime pine and its productive concomitants, but by the cultivation of trees and shrubs adapted to the climatic conditions of another continent. That the greater struggle with nature will succeed no one who considers the conditions there presented and the character of the people who have undertaken it can doubt.

LAND AND FOREST TENURE IN FRANCE.

It is a curious fact that social and political conditions have been not only an important factor of this climatic and economic experiment, but there is a peculiar resemblance between the natural and the artificial conditions which have coöperated to insure success in this struggle between man and nature, which began on the shores of the Gulf of Gascony. The material struggle was carried on not by means of the maritime pine alone, but by it in connection with the undergrowth of all sorts native to this region. The function of this undergrowth was to shade the young pines until they could send their roots down into the moisture that percolates through the sand during the rainy period. In addition to this, they kept piling up the sands which were blown over the crest of the dune and made the foothold of the pines continually firmer, broadening the crest of each dune, and so promoting a mesa-like formation, instead of the sharp, wave-like crest of the dune. It is to the coöperation of these two forces—the deep-rooted pine with the low, clinging undergrowth—that the march of the smothering sands was stayed.

THE TOP OF A DUNE ON THE NEW JERSEY COAST HELD BY A PATCH OE BAYBERRY.

PLANTATION OF BEACH GRASS AND PITCH PINE ON CAPE COD FOR THE FIXATION OF THE SOIL.

In like manner the coöperation of different social and political forces was essential to the result. The tenure of lands in this region consisted of several elements, to wit:

1. The supreme national tenure—what we term the right of eminent domain—which applies to all the lands of France, and may be exercised with or without ousting private ownership. This secures to the government the right to supervise and regulate the planting of the maritime pine by the officers of the department of roads and bridges, so as to secure the best results by making each proprietor's coöperation contribute to the success of all. This power is seldom exercised except by way of suggestion.

2. Feoffage, or the relation which subsisted between the feudal lord and the inhabitants of his domain, to whom he granted certain privileges in consideration of more or less clearly defined services; forestiers, resiniers, and shepherds all owed certain duties to their feudal lords—in this case, Capitaux de Buchs. The resiniers worked his forests for resinous products; the forestiers guarded his forests from waste and spoliation and preserved the game; the shepherds furnished wool and mutton in return for free pasturage. All had a right to gather dead branches in the forests and to use dead trees for housing. As a result, every inhabitant as well as the lord had a definable right in every acre of land and every tree in the forest. There was no such thing as an absolute individual proprietorship, but a triple one. The lord has lost his feudal right, but the French law has preserved, with singular discrimination, the right he held and the obligation he owed to his feudal servitors. These rights have, as a rule, been absorbed by the nation or distributed between the new proprietors and the communes, which are very properly held to have succeeded to the privileges he enjoyed and the obligations he owed.

3. In this distribution of rights and privileges the commune is held to have succeeded to most of the public rights and obligations of the feudal lord. The commune in which land once held by feudal right is situated, must prevent it from being enclosed, so as to destroy or unduly restrict the rights of pasturage or forestry, which have descended to the inhabitants.

4. The private rights or privileges of the feudal lord are held to have descended to the present occupants in all cases where it can be shown that they have acquired the same by purchase or inheritance. In the greater part of this region, however, the right of actual occupancy of the feudal lord was so vague and uncertain that it was impossible to define by metes and bounds the limits of alienation by inheritance or purchase. Because of this, the general forest right—that is, the right of hunting, cutting, enclosing, and working for resinous products—are held to have escheated to the state, and not to the heirs or purchasers, while the rights of communal enjoyment remain to the inhabitants or tenantry, modified only by conditions imposed by law. Every resident of the forest enjoys all the rights which attached to his ancestor—or the person whose right he has obtained by purchase—except as they may be modified by the action of the commune.

The result is that there are hundreds of square leagues on which the pines can not be worked for turpentine nor cut for timber. Over these free passage is allowed, and every habitant has a right to gather dead wood and utilize the common pasture. When one purchases or leases unoccupied land which has no timber on it the right of the habitant still subsists, and the trees, the proprietor plants, are subject to the same conditions as previously attached to the land purchased. He may extinguish the right of pasturage by negotiating with the commune and acquire from the government the right to work and cut the trees he cultivates, but the rights of the forestiers are held to be practically inextinguishable. They still have the right to gather dead wood and fallen timber even on the plantations erected and cultivated by the occupant.

The result of these curiously complicated conditions is that every person living on an ancient feudatory has an individual, inheritable, and inalienable interest in every tree and shrub and every grain of sand in the common forest. There is no such thing as an absolutely exclusive ownership in any of the lands not distinctly aliened by the ancient feudatory. Such ownership can only be secured or exercised by special and concurrent grant of all the parties in interest—the state, the commune, and the occupant. By obtaining these the purchaser may obtain the right to enclose, to cultivate, or to work and cut to the exclusion of all others, but if his timber is killed by fire the rights of the forestiers to cut and use is held to attach, and can only be released by individual renunciation.

WHERE MARITIME PINE FLOURISHES.

The maritime pine is now planted in large quantities as a matter of profit by the owners of sandy lands which are properly located. As its name implies, it prefers an exposure to sea air and does not object to a subsoil having a brackish impregnation. It does not succeed where it meets a temperature below zero for any considerable time, nor in a continuously dry climate. A location subject to severe drouths, with a dry subsoil in a climate like that of the northern part of the United States, is not likely to prove suitable for the growth of this tree.

There are now nearly 700,000 acres of maritime pine growing in France, one-third of which is under control of the government and two-thirds in private ownership. The trees are usually grown in nursery rows, carefully protected by mulching or some sort of low growing shrubs or grain for two or three years, and then set out in the plantations. Those who have recently purchased seeds of this variety of pine for cultivation in the United States would do well to consider the essential characteristic of its habitat; also the fact that in removal from the nursery the roots must not be exposed so as to become

dry even for the briefest period. After twelve years they become, under ordinary circumstances, large enough to be "worked" for resin, which they continue to yield for thirty years, and are then cut for timber.

The lesson of this wonderful one hundred years of experiment is not restricted to reforestation by means of the maritime pine alone, but extends to all woods used for that purpose, and is that the conditions of the natural habitat must in all cases be observed in order to secure success.

FORESTS OF THE HAWAIIAN ISLANDS.

FOREST DESTRUCTION A MENACE TO PROSPERITY—CATTLE VERSUS WATER—WHAT THE GOVERNMENT IS DOING TO BETTER CONDITIONS.

IN the Hawaiian Islands it is now recognized that forest preservation is a matter of great and immediate importance to the leading economic interests of the territory. The chief agricultural interest of the islands is sugar-growing. In 1903 the exported sugar was valued at $25,310,684, or 96 per cent of the total exports. The supply of water on which successful cane cultivation depends comes to a large extent from the forested higher slopes of the mountains above the plantations. But the situation is complicated by the fact that cattle-raising, which in economic importance stands second only to the sugar industry, depends largely on the use of the forest for range, and overgrazing has been the principal cause of injury to the water-holding power of the wooded area.

As a preliminary to the formulation of a far-sighted policy in the interest of the islands as a whole, the territory a year ago asked for an examination of the whole question on the ground by

IE-IE VINE IN LEHUA FOREST.

an agent of the United States Department of Agriculture. The report of Mr. William L. Hall, of the Bureau of Forestry, who made the examination, is now being printed as Bulletin No. 48, "The Forests of Hawaii." Both from a scientific and practical standpoint, it gives much information concerning these Hawaiian forests and their uses.

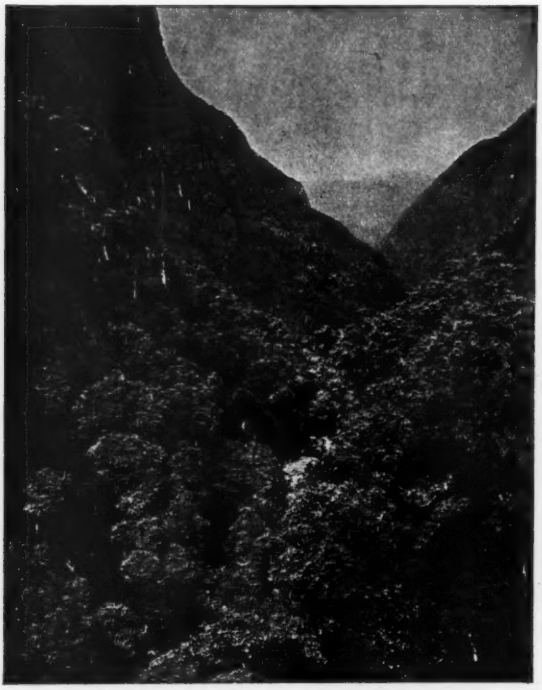
Only five of the eight islands are large enough to be important in a forest study. In these there are two distinct kinds of forest—one near sea-level in the drier portions of the islands, the other in the regions of heavy rainfall on the mountain slopes. They never blend or even meet. The forest of the sea-level is made up exclusively of mesquite, so prevalent in the drier sections of the southwestern part of the United States. In the Hawaiian Islands, however, it grows much denser, taller, and straighter than in the States, having changed its habit of growth in response to altered conditions. It is not native, but was introduced in 1837 by a seed planted in Honolulu. The tree still stands in a healthy condition, having a diameter of 2 feet and a height of 50 feet. From it have sprung 50,000 acres of mesquite, or, as there called, algaroba forests, divided among the several islands. The wood is chiefly valuable for fuel and fence posts. The forests are exceedingly important as furnishing a cover for the soil and abundant food for stock. The mesquite pods are eaten by cattle in summer, as they fall to the ground from the trees, and are gathered and fed dry all through the year. Because of these uses and the wonderful powers of reproduction and extension which the algaroba forests possess, they are a most valuable asset of the islands.

UNDERGROWTH IN A MOUNTAIN COVE.

The native forests are those of the mountain slopes, and are all essentially of a tropical character. About three-fourths of the native forests are composed of lehua. This tree is found in regions of heaviest rainfall, and under best conditions attains a diameter of 4 feet and a height of 100 feet. Commercially, except for fuel, the wood has little value, for in drying it checks and warps badly. Its importance is as a protective forest. Its stand is thin, but

FOREST NEARLY RUINED BY GRAZING, NORTH KOHALA, HAWAII.

FOREST ENTIRELY RUINED BY GRAZING, MAUI.



KUIKUI FOREST, BOTTOM AND SIDES OF DEEP GULCH.

the most luxuriant undergrowth is always found beneath its small-crowned trees. Indeed, so luxuriant is this undergrowth of ie-ie vine and similar climbers, fern growth ranging from a few inches to 30 feet in height, and mosses, that virgin forests of lehua are often impenetrable, dark jungles. Thus an ideal condition is created for water conservation.

The present forest area is about 20 per cent of the islands—a small fraction of what it was a hundred years ago. The destruction of the forests can be traced to three chief causes—clearing for agriculture, stock grazing, and grass encroachment. Cattle were taken to the islands in the eighteenth century, and for years were protected by rigid laws forbidding their slaughter. By 1815 they had so increased in number as to become a menace. The anti-slaughter laws were repealed, and gradually their number has been reduced to the needs of the islands; but their work of destruction had been accomplished. Much of the undergrowth of the native forests was of a succulent character, peculiarly agreeable not only to cattle, but also to goats, pigs, and deer. All of these preyed upon the forest, and year by year their trampling and grazing showed more plainly in forest areas wrecked and ruined. The encroaching grasses occupied the ground and prevented reforestation. In the rainy districts the Hilo grass and in the drier sections Bermuda grass was the offender. Between them they occupy vast stretches of country that were once well forested.

Clearing for agricultural and homestead purposes is responsible for very much of forest destruction. Since the best use to which the lands of the islands can be put is agriculture, no fault can be found with such cutting, provided it is not carried so far as to curtail the water supply on which agriculture itself depends. The rainfall of the forested portion of the islands is from 50 to 200 inches a year, and the native forests furnish the best floor conditions for storing away this water for future use; but when the forest area is made smaller, the storage supply of water is lessened. In addition, it appears to be true in Hawaii that forests influence the amount of moisture precipitated. Where the mountains, with their cooling atmosphere, do not extend their elevations above 3,000 feet, forests are especially needed. The trade winds bring in fogs and mists, and the forests perform the excellent function of changing these to water and leading it to the ground for storage. Thus, continued forest cutting means danger both to the amount of

water precipitated and to the supply husbanded for the crops. Both the principal crops, sugar and rice, require much water for their successful growth.

Already public opinion in the islands has taken form in practical forest preservation work. Sugar companies have established reserves for local protection, the area in one case being as large as 50,000 acres. Tree planting has been done on a large scale by a number of land-owners. The government began tree planting twenty-two years ago with an appropriation of $12,000. A conclusive step was taken when the last legislature provided for a forest policy, and entered upon determined work to protect and utilize the forests to the best advantage. The first act to this end must be the establishment of forest reserves, which should include practically all the mountain forests. Fortunately, the government owns most of these forests, although at present they are largely under lease to private individuals, mainly to cattlemen. It is thought, however, that an exchange of these lands can be brought about. When the reserves are established, a first necessity will be the extermination of the wild cattle and goats and the creation of a ranger service to keep out fire and stock. Where reproduction is not rapid, and upon badly denuded lands, tree planting must be done to supplement the natural forest. It is believed that trees of greater commercial value than those native to the islands can be successfully planted.

The conflict of interests between the cattlemen and the sugar-planters is evident, but need not seriously menace rehabilitation of the forests. The cattlemen in many instances desire the forests for pasturage. The planters rightly contend for the intact forest with perfect floor cover to secure the greatest possible storage of water for the supply of growing crops. But the clashing of interests is happily reduced by other conditions, chief of which is that sugar-growing is the great sustaining industry and the dominant source of income. An additional potent factor is that many cattle-raisers are also sugar-growers, and their double interests compel them to take the broadest view of the needs of the islands as a whole.

The Bureau of Forestry has supplied the islands with a forester, and is actively coöperating with the territorial authorities in all matters of policy.

THE NEW MONTANA.

TO LEAD IN IRRIGATION AND MINING.

BY

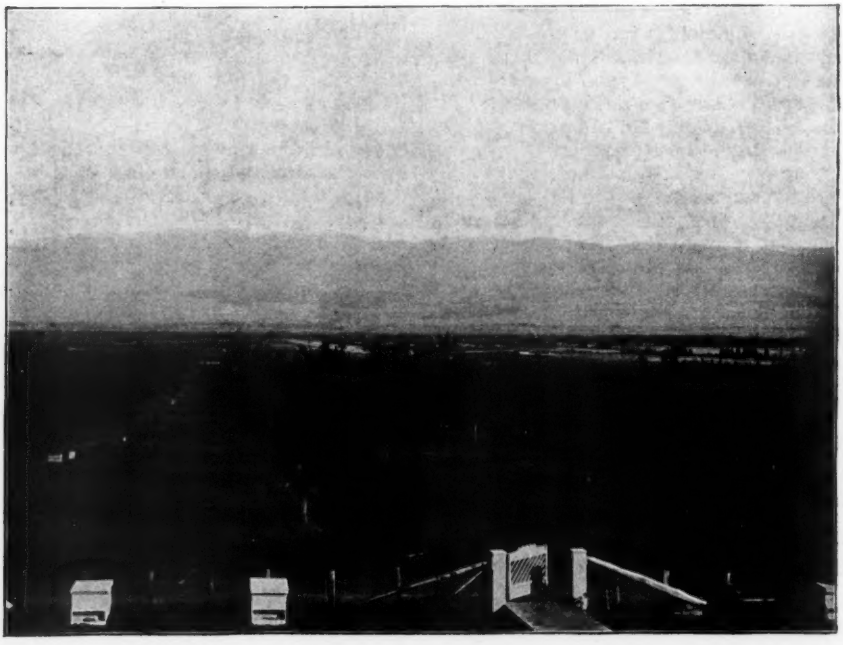
GUY E. MITCHELL.

THE great copper, silver, and gold mines of Montana, the "Treasure State" of the Union, potent as has been their influence in her development, and while they are yet far from their maximum output and value, must soon take a second place in the state's resources. It is Montana's destiny to be one of the richest agricultural states in the Union. As the agriculture of Colorado, now the foremost state in the production of precious metals, has already outstripped her mines, so in a few years will Montana's farming lead her mines.

With lands of surpassing fertility, in which agricultural plant food has lain stored for centuries, with no drenching rains to leach them away, and with a magnificent water supply from the rain and snows which fall upon the high peaks and watersheds of the Continental Divide, Montana's fat cattle and sheep, splendid fruit, heavy grains, and varied agricultural products will become widely famous.

GREAT AGRICULTURAL WEALTH.

"The next ten years," said a prominent official of the Government Reclamation Service, in speaking of the great present and coming development of the far northwest, "will see Montana lead all the Western States in the area of her irrigated land. Its agricultural future is assured and brilliant. It has the land and it has the water—all that are needed in the arid region to produce fabulous wealth."



A FRUIT FARM IN THE BITTER ROOT VALLEY, MONTANA; THE RESULT OF IRRIGATION.

Montana has an area equal to that of France. It has often been stated by various authorities, with all its great water supply conserved and made to irrigate its rich lands, within its boundaries there will be room for as dense a population as that of France.

Over three-fifths of this great state is drained by the Missouri River and its tributaries, the Yellowstone, the Jefferson, Milk River, and other branches. Strong rivers these are, rushing down out of their mountain fastnesses—the Absaroka, the Snowy, the Big Horn, and the Wind River ranges—where, at elevations of eight and ten and eleven thousand feet, the snows are perpetual, melting under the summer suns and furnishing a constant water supply, especially in the late summer, when it is most needed for irrigation.

Much has already been accomplished by coöperative effort in irrigation among farmers. The irrigated area, according to the census figures, has increased during the past two years at the rate of about 100,000 acres a year, and now aggregates 1,140,000 acres. This has been accomplished by the coöperation of small communities, and some of the most successful examples are seen at such places as Hinsdale and Chinook, in the Great Milk River Valley, where farmers have combined, taking up land under the five-year homestead law and constructing their own irrigation works, thus owning the land and the water

and paying no rent or tribute to water companies or water bondholders.

SMALL COST OF IRRIGATED HOMES.

Most of these works have been simple diversion propositions without expensive dams and the cost has been very light, land reclamations averaging, according to the 1900 census, but $4.92 per acre. The opportunities are legion where bands of twenty or forty or one hundred enterprising farmers with a little money and with their strong arms and good teams may build diversion or storage dams and lead the water out upon 160-acre homestead claims, building up homes upon the desert which will make each and every one of them prosperous. The great productivity of Montana's lands is shown by the census figures. The total amount invested in ditches in Montana up to June 1, 1900, was $4,683,073, while the total value of irrigation products for the one year, 1899, was $7,230,042.

At the rate of increase in farming and irrigation in the state during the last census decade, the next ten years will see Montana's cultivated area trebled, if not quadrupled, even leaving out of consideration the vast reclamation works proposed by the federal government under the national irrigation law.

CHANGING THE COURSE OF NATURE.

The project for storing the flood waters of the Milk River in northern Montana, under the direction of District Engineer Cyrus C. Babb, of the U. S. Reclamation Service, is one of the first great works investigated by the government engineers, even before the passage of the national irrigation act. This involves huge dams and canals, and will reclaim, when carried to full completion, a very large area—probably half a million acres—of exceedingly rich land in the already famous Milk River Valley. It will be a famous engineering exploit, by which the water now flowing into the Saskatchewan, and thence into Hudson Bay, will be carried into the Missouri Basin and ultimately reach the Gulf of Mexico. The government has also taken up the Fort Buford project in eastern Montana and North Dakota, and is likewise preparing to spend $2,500,000 in the Wyoming-Shoshone project, which will reclaim some of the lands of southern Montana. These are the most advanced of the government works. In various other parts of the state the national hydrographers are making reconnoissances and surveys, investigating reservoir sites and reclaimable areas.

A serious menace, however, to the agricultural future of the state lies in the tendency to land absorption into immense private holdings, which have resulted largely through the abuse of the desert-land act and the commuters' clause of the homestead act, under which government land is entered by speculators and dummies and not by actual settlers. W. W. Wooldridge, president of the Montana Fruit Growers' Association, in a recent address cited 11 great ranches in Montana with an average acreage each of 55,000 and showed statistically the greater benefit which would have come to the state had these been settled up into several thousand small farms and occupied by settlers and their families. There seems to be a strong sentiment throughout the state for the repeal of these laws, leaving only the original homestead law, which has worked so successfully in building up coöperative irrigation colonies in the Milk River Valley.

IRRIGATION INCREASES MINING.

All of this great promise of agriculture will, however, but add to Montana's fame as a mining state. "Speaking from a miner's standpoint," said the Geological Survey official quoted above, "Montana's surface has been but indifferently scratched. We know that whole mountains exist of ore too expensive to work because the cost of living for man and beast is too high. The state has thousands of other mountains of which we know little or nothing. Montana is a vast country of itself; the mountains of its western half cover thousands and tens of thousands of square miles. Now, if we extend agriculture throughout the state, lead the great streams out of their deep channels and spread them over some millions of acres of arid soil, and this mountain wealth can be turned to man's account, railroads will penetrate the desert, and Montana can almost supply the world with the metals."

WORK OF BUREAU OF FORESTRY.

FIELD PROGRAM FOR AUGUST, 1904, WITH FULL LIST OF PERSONAL ASSIGNMENTS.

A SCHEDULE of field work and assignments in the Bureau of Forestry is being issued monthly during the field season in order to keep the various members of the Bureau more closely in touch with the work as a whole and with each other. The growth of the forest movement, and especially of the government forest service, can in no way be more clearly shown than in the list of projects now under consideration by the Bureau of Forestry. For this reason its various lines of work and the men assigned to them are given in full here. It will be seen that the federal government is at the present time carrying on forest work of a varied nature in thirty-one states and territories.

ADMINISTRATION.

Gifford Pinchot, Forester, Brown Palace Hotel, Denver, Colo., August 3–5; Boise, Idaho, August 7, 8; return to Boise about August 13; return to Washington about September 7.

Overton W. Price, Associate Forester, Washington, D. C.

Geo. B. Sudworth, Chief of Dendrology, Washington, D. C., until August 20

Thomas H. Sherrard, Chief of Forest Management, Washington, D. C.

William L. Hall, Chief of Forest Extension, Washington, D. C.

F. E. Olmsted, inspection of field work.

E. T. Allen, Acting Chief of Section of Reserve Boundaries, Washington, D. C.

Hermann von Schrenk, Chief of Forest Products, Missouri Botanical Gardens, St. Louis, Mo.

ALABAMA.

Working plan for tract of Emmet O'Neal in northern Alabama, in coöperation with the owner, H. W. Chittenden.

ALASKA.

Examination of lands for forest reserves and additions to existing forest reserves, W. A. Langille.

ARKANSAS.

Experiments in seasoning of red and other inferior oaks, in charge of M. C. Jensen, Black Rock, Ark.; assistant, M. Smith, Jr.

CALIFORNIA.

Study of forest problems, in coöperation with the state, W. C. Hodge, Jr., in charge; headquarters, Occidental Hotel, San Francisco, Cal.; assistants, W. F. Hubbard, E. H. Hareford, P. D. Kelleter, C. G. Smith, A. R. Powers, A. E. Cohoon.

Study of sugar pine and western yellow pine, under direction of A. W. Cooper; assistants, W. J. Wade, R. H. Allen, W. L. Porterfield, G. J. Traugott, B. J. Teasdale, R. R. Secrest, G. H. Cecil.

Study of tanbark oak on Pacific coast, Prof. W. L. Jepson; permanent address, Berkeley, Cal.

Special studies of California trees, four-leaf pine (*Pinus quadrifolia*), Torrey pine (*Pinus torreyana*), bishop pine (*Pinus muricata*), Prof. W. R. Dudley; permanent address, Stanford University, Cal.

Study of native and exotic acacias, Prof. A. V. Stubenrauch; permanent address, Berkeley, Cal.

Coöperative planting plan for Griffith Park, in charge of G. B. Lull, Hollenbeck Hotel, Los Angeles, Cal.; assistants, H. O. Stabler, C. H. Sellers, T. C. Zschokke.

Work on the government nursery, San Gabriel Forest Reserve, under direction of T. P. Lukens, Pasadena, Cal.; assistants, A. T. Searle, W. F. Sherfesee.

Study of chaparral, Santa Barbara Forest Reserve and Southern Sierras, direction of L. C. Miller, Hollenbeck Hotel, Los Angeles, Cal.; assistant, W. R. Mattoon.

Study of forest reproduction, southern Sierras, in charge of J. D. Guthrie, Santa Barbara, Cal.; assistant, S. J. Flintham.

Study of forest fires and methods of prevention, northern California, in co-

operation with the State, E. A. Sterling, Occidental Hotel, San Francisco, Cal.

Timber tests on red fir and Western hemlock, in coöperation with the University of California, Prof. L. E. Hunt, Berkeley, Cal.; assistant, R. Thelen.

COLORADO.

Establishment of forest nurseries, Pike's Peak Forest Reserve, under direction of Clyde Leavitt, Rosemont, Colo.; assistant, T. J. Taylor.

CONNECTICUT.

Timber tests, with special reference to the influence of moisture on strength of Southern pines, in coöperation with Yale University, Prof. J. W. Toumey and H. D. Tiemann, Yale Forest School, New Haven, Conn.; assistant, C. Barry.

DISTRICT OF COLUMBIA.

Timber tests, with special reference to rates of growth of Southern pines, H. S. Betts, Washington, D. C.; assistant, P. Hubbard.

Study of germination of pine seeds, in coöperation with Seed Laboratory at Washington, D. C., and on Dismal River Reserve, J. C. Blumer; address, Bureau of Forestry, Washington, D. C.

Tabulation and preparation of wood preservation, data from U. S. Census reports and from field, C. G. Crawford, Washington, D. C.

GEORGIA.

Improved methods of turpentine orcharding, experimental pine forests (orchards), secured by coöperation with Powell, Bullard & Company, Frank Klarpp, Ocilla, Ga.; assistant, S. P. Woolfolk.

HAWAII.

Examination of lands for insular forest reserves, R. S. Hosmer, Honolulu, Hawaii.

IDAHO.

Working plan for Northern Pacific Railway Company in Idaho, in coöperation with the company, under direction of A. K. Chittenden, St. Maries, Kootenai Co., Idaho; assistants, G. M. Homans, K. W. Woodward.

Preparation of forest map of Idaho, Smith Riley, Kooskia, Idaho; assistants, G. E. Tower, W. T. Cox.

ILLINOIS.

Study of the results of forest planting, central Illinois, R. S. Kellogg, Roodhouse, Ill.; assistants, H. M. Hale, J. M. Nelson, Jr., M. B. Pratt, F. J. Phillips, E. A. Ziegler.

INDIANA.

Timber testing at Lafayette, Ind., in coöperation with Purdue University, Dr. W. K. Hatt, Lafayette, Ind.; assistant, C. H. Hall.

IOWA.

Study of results of forest planting and preparation of planting plans, in cooperation with landowners, H. P. Baker, Ames, Iowa.

KANSAS.

Preparation of planting plans, in cooperation with landowners, Z. L. Bliss (also in Nebraska).

KENTUCKY.

Working plan for Hillman Land and Iron Company in western Kentucky, in coöperation with owners, directed by A. B. Patterson, Eddyville, Ky.; assistants, W. H. von Bayer, A. C. Ringland, J. E. Barton, J. H. Hausenvald, W. J. Morrill, T. L. Hoover, J. B. Anderson.

MAINE.

Study of fire prevention and control, in coöperation with the state, S. N. Spring, Orono, Me.; assistants, L. Margolin, E. R. Hodson, J. H. Ramskill, P. T. Harris.

MINNESOTA.

Inspection of lumbering, marking of timber, and forest measurements upon lands to become the Minnesota National Forest Reserve, under direction of E. S. Bruce, Cass Lake, Minn.; assistants, G. E. Marshall, W. E. La Fountain, R. G. Giffin, W. R. McKinnon, M. Burns, W. Wallace, J. S. Baird.

MISSOURI.

Louisiana Purchase Exposition, St.

Louis, exhibit of Bureau of Forestry, Alfred Gaskill, Forest, Fish, and Game Building, World's Fair, St. Louis.

Study of methods of wood preservation, Louisiana Purchase Exposition, St. Louis, in coöperation with various railroads, G. E. Clement, Missouri Botanical Gardens, St. Louis, Mo.; assistant, R. W. Ayres.

Special timber tests, Louisiana Purchase Exposition, in coöperation with various railroads, Dr. W. K. Hatt; headquarters, Purdue University, Lafayette, Ind.; assistants, H. D. Hartley, G. W. Noyes, and M. Cline, Missouri Botanical Gardens, St. Louis, Mo.

Chemical experiments, with special reference to wood preservation and moisture contents of wood, St. Louis, E. B. Fulks, Missouri Botanical Gardens, St. Louis, Mo.

MONTANA.

Study of western yellow pine, S. J. Record; assistants, M. Rothkugel, J. F. Bond.

NEBRASKA.

Work on Government nursery, Dismal River Forest Reserve, C. A. Scott, Halsey, Nebr.; assistants, F. W. Besley, W. H. Mast, F. B. H. Brown, E. C. Clifford, H. C. Neel, A. E. Oman, T. D. Woodbury.

Study of results of forest planting, eastern Nebraska, F. G. Miller, station A, Lincoln, Nebr.; assistants, L. M. Goodding, W. I. Hutchinson, G. W. Peavy, J. D. Warner, L. L. White.

Study of forest replacement in Nebraska, Dr. Chas. E. Bessey, Lincoln, Nebr.

NEW HAMPSHIRE.

Working plan for Ansel Dickinson estate in southern New Hampshire, in coöperation with the owner, C. A. Lyford, Ashuelot, N. H.; assistants, W. B. Piper, A. T. Boisen.

NEW MEXICO.

Seasoning and treating experiments and tests of special forms of ties, in coöperation with Southern Pacific and Sante Fé Railroads, H. A. Paul, Las Vegas, N. M.; assistant, F. Dunlap.

NEW YORK.

Execution of working plan for U. S. Military Academy, West Point, N. Y., in coöperation with the War Department, R. L. Marston; permanent address, 270 Crown street, New Haven, Conn.

Seasoning experiments on maple, beech, and birch cross-ties, with special reference to different methods of piling, in coöperation with New York Central Railroad, W. R. Wheaton, Utica, N. Y.

Preparation of report on European nursery methods, W. F. Fox, Albany, N. Y.

NORTH CAROLINA.

Seasoning experiments on juniper poles, with special attention to effect of rafting, in coöperation with American Telegraph and Telephone Company, D. G. Kinney, Wilmington, N. C.; assistant, J. Appleton.

SOUTH DAKOTA.

Commercial tree study of western yellow pine in South Dakota, H. M. Curran; assistants, J. E. Keach, F. L. Pray, C. L. Hill, F. M. Patton, E. G. Cheyney.

Study of results of forest planting, Sioux Falls to Brookings, J. M. Fetherolf, Sioux Falls, S. Dak.; assistants, J. P. Wentling, H. B. Holroyd, S. G. Smith, O. T. Swan, L. von Wernstedt.

Inspection of field-work, G. L. Clothier (also in Illinois and Nebraska, and preparation of planting plans in Oregon).

TEXAS.

Working plan and planting plan for New York and Texas Land and Cattle Company, in western Texas, in coöperation with the company, H. H. Chapman, Amarilla, Tex.; party from forest extension, J. Fred Baker, W. B. Hadley, A. S. Peck.

Investigation of different methods of piling and laying ties and tests of special forms of ties, in coöperation with Southern Pacific and Santa Fé Railroads, F. Tompkins, Somerville, Tex.

Tie seasoning experiments, in coöperation with the Southern Pacific and

Santa Fé Railroads, H. J. Brown, Silsbee, Tex.; assistant, C. E. Feagin.

Study of forest conditions of the Big Thicket country, Prof. W. L. Bray, Austin, Tex.

UTAH.

Study of forest reproduction preparatory to forest planting, Salt Lake Forest Reserve, A. F. Hawes, Salt Lake City, Utah; assistant, C. D. Mell.

WASHINGTON.

Working plan for Weyerhaeuser Timber Company in Washington, in coöperation with the company, C. S. Chapman, care Weyerhaeuser Timber Company, Tacoma, Wash.; assistant, H. D. Everett.

WEST VIRGINIA.

Working plan for United States Coal and Oil Company in West Virginia, in coöperation with the company, R. C. Hawley, Holden, W. Va.; assistants, C. H. Farnum, A. O. Waha, F. A. Silcox, J. B. Dumont, C. A. Mathewson, C. J. Buck.

WISCONSIN.

Study of forest conditions, in coöperation with the state, E. M. Griffith, Madison, Wis.; assistant, R. F. Nash.

WYOMING.

Study of lodge-pole pine, P. G. Redington.

REGIONAL STUDIES.

NEW ENGLAND.

Preparation of planting plans, in cooperation with land-owners (also in Ohio Valley), S. B. Detwiler.

EASTERN STATES.

Location and measurements of permanent sample plots, Prof. H.S. Graves, Milford, Pa.; New Haven, Conn.; assistant, G. H. Myers.

SOUTHERN APPALACHIANS.

Studies of Southern hardwoods, Walter Mulford, in Tennessee; assistants, W. B. Greeley, preliminary examinations in Tennessee; H. D. Foster, preliminary examinations in North Carolina; H. G. Merrill, with working-plan party on tract of United States Coal and Oil Company in West Virginia; J. S. Holmes, commercial tree study at Townsend, Tenn.; D. Skeels, T. A. Casey, J. R. Weir, J. E. Gow, H. D. Burrall, W. H. Kempfer, J. E. Lagdameo.

MIDDLE WEST.

Study of second growth, R. G. Zon.
Woodlot examinations, W. G. Weigle.

WESTERN STATES.

Seasoning and treating experiments in Washington, Wyoming, New Mexico, and Texas, in coöperation with the Northern Pacific, Southern Pacific, and Santa Fé Railroads, R. P. Imes; headquarters, Missouri Botanical Garden, St. Louis, Mo.

Tie-seasoning experiments on lodge-pole pine and western hemlock, Sheridan, Wyo., and Tacoma, Wash., in cooperation with Northern Pacific Railroad, H. B. Eastman.

Examination of lands for new forest reserves, additions to existing forest reserves, and releases of reserved lands:

Inspection of field-work, Henry Grinnell.

In Montana and Wyoming, Coert Du Bois; assistants, Elers Koch, J. H. Hatton, W. H. B. Kent.

In Colorado, Utah, New Mexico, and Arizona, R. E. Benedict; assistant, R. V. R. Reynolds.

In Washington, Oregon, and California, H. J. Tompkins; assistants, R. B. Wilson, F. W. Reed.

Study of forest grazing, A. F. Potter.

FLOODS OF 1903.

DATA COLLECTED ON THE UNUSUALLY DESTRUCTIVE FRESHETS OF LAST YEAR, WITH SUGGESTIONS LOOKING TO RELIEF IN FUTURE.

THE year 1903 had perhaps more than its fair share of natural calamity—of flood and fire and famine. In the United States during May and June there were three notable floods which caused serious loss of life and great destruction of property, one in Oregon, one in South Carolina, and one in Kansas. A recent publication of the United States Geological Survey, scheduled as Water Supply and Irrigation Paper No. 96, contains a discussion of the various phenomena connected with these floods, and suggests means for minimizing the destructiveness of future deluges. The author of the paper is Mr. E. C. Murphy.

The flood of shortest duration occurred on Willow Creek, Morrow county, Oregon, Sunday evening, June 14, 1903. It was the result of what is popularly called a cloudburst, a heavy rainstorm of short duration covering a very small area and peculiar to arid regions. The flood that rose as the result of the heavy downpour of rain lasted less than an hour, but in that short space of time one section of Heppner, a town with a population of about 1,400, was swept entirely away, a quarter million dollars' worth of property was destroyed, and more than 200 people were drowned. The great loss of life was partly due to the peculiar construction of the houses in Heppner. Nearly all these houses were built on posts of wood or stone, from which the flood lifted them and carried them away to be dashed to pieces against trees and other obstructions.

The South Carolina flood occurred on June 6, 1903, and continued for nearly twenty-four hours. In that time there was a rainfall of from 3½ to 5 inches over an area of about 2,500 square miles on the southern slope of the Blue Ridge-Saluda Mountains, including parts of Cherokee, Spartanburg, and Pickens counties, in South Carolina, and Rutherford, Polk, and Henderson counties, in North Carolina. This area is drained by three small tributaries of Broad River, known as the Pacolet, Tiger, and Enoree. The principal damage wrought by the flood was on the Pacolet, where numerous cotton mills were ruined and much railway property was destroyed.

The Kansas flood occurred during the last week of May and the first week of June. It affected a much larger area than either the Heppner or South Carolina flood and was due to a storm that lasted nearly a week.

The United States Geological Survey has fortunately six gaging stations in the watershed of the Kansas River, and has, therefore, a comprehensive record of the surface fluctuations of the river and its principal tributaries during the flood. The records at Lawrence and Lecompton, on the Kansas River, cover a period of 22 years. The estimated flow of the Kansas River on May 31 was 225,400 cubic feet per second. In other words, if there had been a storage reservoir 1 acre in area and 7½ feet in depth on each section of the whole drainage area of the Kansas River, the water flowing into the river on May 31 was sufficient to have more than filled all of them.

The whole river bottom was flooded, crops were destroyed, stock was drowned, wooden buildings were lifted from their foundations and brick houses crumbled and fell, railroads were undermined, and bridges were swept away. Traffic in eastern Kansas was almost entirely suspended for two weeks. The property loss in Kansas and in Kansas City, Missouri, is estimated to have been no less than $22,000,000.

Among the subjects considered in this paper are the effects of ground storage, of cultivation, and of forests in reducing the magnitude of floods. The effect on streams of dams, of bridge piers, and abutments is discussed; also the danger of building out into streams, thus narrowing the waterway and increasing the magnitude of floods. The relief afforded by straightening the channel is mentioned and the use of levees is explained.

THE ROSWELL ARTESIAN BASIN.

DATA CONCERNING A VALUABLE ARTESIAN BASIN IN THE PECOS VALLEY IN NEW MEXICO.

AN investigation of this important artesian basin has just been completed by Mr. C. A. Fisher, a geologist of the U. S. Geological Survey. His report, giving a large amount of interesting and valuable data, will be issued by the Survey in the near future.

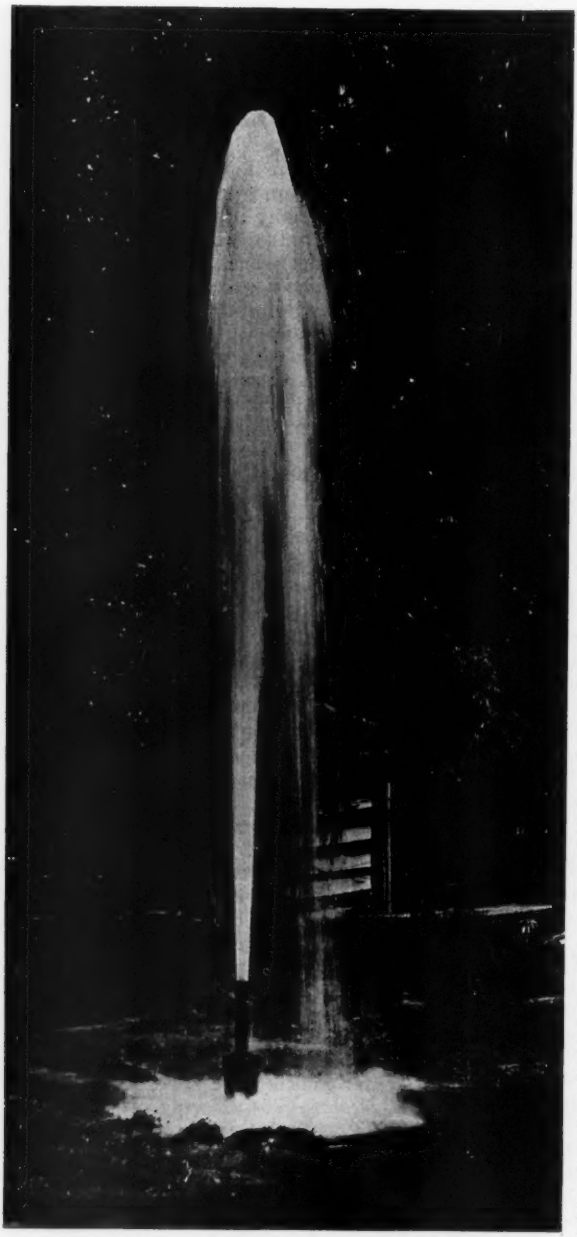
Location.—The Roswell artesian basin is located in the Pecos Valley, in southeastern New Mexico. It occupies an area varying from 6 to 8 miles in width, and extending from a point a few miles north of Roswell, New Mexico, to near the mouth of Seven River, a distance of about 60 miles. The greater part of this area lies along the west side of Pecos River, the surface rising very gradually toward White and Sacramento mountains. The eastern limits of the basin are determined by moderately high bluffs, which follow the general course of the river throughout the entire length of the basin. The western margin is not indicated by any topographic feature, but flows are obtained on the gradual slope to an altitude equal to that of North Spring Lake, the apparent head of the Roswell artesian waters.

Character of Rocks.—The rocks of the district comprise limestone, sandstone, clays, and gypsum, which are believed to be of the Permian age. Overlying these deposits are extensive sheets of sand, gravel, and clay, laid down in successive terraces between the river and the high limestone slopes to the west. For convenience the Permian beds may be divided into three groups, the upper gypsum beds forming high bluffs on the east, the red sandy series which underlie the valley, and the massive limestones comprising the rugged slopes to the west. The beds have a uniform dip of about 4 degrees to the eastward. The gypsum series has an average thickness of about 300 feet, while the red sandy series immediately underneath reaches a thickness of about 600 feet in the south end of the basin. To the north the thickness of the formation has been greatly reduced by erosion, especially in the vicinity of Roswell, where it scarcely exceeds 100 feet. The underlying massive limestones reach a very great thickness in this general region, but it is only the uppermost member, a porous, sandy limestone, with which we have to deal in the present consideration.

Distinct Horizons.—There are four or more distinct artesian water horizons occurring in the Permian beds of the Roswell basin. Three of them are found in the lower part of the red sandy series, while the fourth and strongest flow is in the porous sandy limestone.

Source of Supply.—These water-bearing formations outcrop in successive zones on the slopes to the west, where they receive their water supply by direct absorption from rainfall and the sinking of streams. The Hondo, Felix, and Penasco are the most important sources of supply in this area. These streams all rise high on the slopes of the El Capitan, White, and Sacramento mountains, where the annual rainfall is relatively large. As a result they carry an abundance of water in their upper courses, all of which sinks in the outcrop zone of the porous sandy limestone and the overlying sandy series, and passes underground to the eastward. After the water has entered these porous formations it is held down by impervious layers of limestone and clays, and under the lower lands eastward it is under considerable pressure.

Depth.—The flowing wells of this district vary from 50 to 800 feet in depth, the shallowest ones occurring in the low valley lands east of Roswell. To the south this main flow is reached at a much greater depth, due to the presence of beds belonging to the upper part of the red sandy series. In sinking an artesian well in the town of Roswell it is necessary to pass through

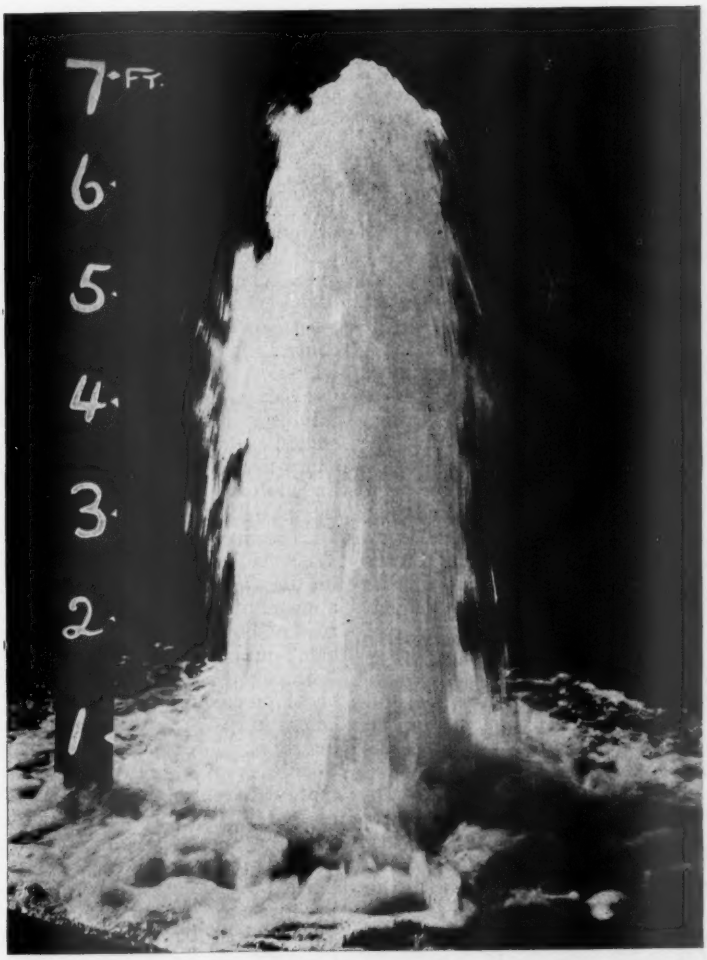


ARTESIAN WELL NEAR ROSWELL, NEW MEXICO.

about 75 feet of alluvium, an equal thickness of red sandy clay, and to penetrate the porous sandy limestones to a depth of 70 to 80 feet before the main flow is obtained. In the region of Hagerman and Artesia the red sandy series is represented by about 600 feet of sediment, and as the overlying gravels are somewhat thicker, the total depth to the main flow is correspondingly deeper.

Pressure.—In the wells thus far examined the pressure varies from 8 to 80 pounds to the square inch. The number of pressure measurements which have been taken, however, are not great, and subsequent investigation may modify these figures. The strongest pressures are found in the vicinity of Artesia, where at present the greatest development in well boring is taking place. Some of the larger wells in this region have a flow of 1,700 gallons per minute, but the average flow is much less.

Decrease in Flow.—At the present time there are at least 40 well machines at work in the district, some of which are of the most improved type. Many new machines are also being brought in. As a result many wells are being completed each month. At present there appears to be no evidence of a decrease in flow, but it is feared that the multiplicity of wells may eventually lower the water plane, and provision



VIEW OF THE LARGEST ARTESIAN WELL IN THE PECOS VALLEY, NEAR ARTESIA, NEW MEXICO. IT FLOWS OVER 3,000 GALLONS A MINUTE.

has recently been made for the systematic measurement of pressure each month of representative wells throughout the basin. In this way any diminution of the flow due to additional wells may be readily detected.

There is great need for the practice of greater economy on the part of water users of the Roswell artesian basin, and very few wells are provided with valves for shutting off the water when it is not in use.

FOREST FIRES IN MAINE.

THE BUREAU OF FORESTRY WILL COÖPERATE WITH THE STATE IN A STUDY OF THEIR CAUSES AND RESULTS AND FOR THEIR PREVENTION.

LAST year Maine, like some other Eastern States, had the most disastrous fires in its history. A timberland area of more than a quarter million acres was burned over, entailing a loss beyond a million dollars. Drouth, unprecedented in severity, had prevailed from April 8 to June 9, and the forests were in a most inflammable condition. There were within sixty days 260 different fires in the burned-over districts. In strong contrast with the experience of New York in the Adirondacks, only three of these are positively known to have been of incendiary origin. Maine had just put into operation a new law amendatory of its forest fire warden service. But for the more efficient work done under this law, the fire loss would have been much greater.

To secure the information which may form the basis for protective measures against future losses on such a scale, and ascertain what can be done to repair the damage already suffered, the state authorities have arranged for a coöperative fire study of the Maine forests by the Bureau of Forestry of the U. S. Department of Agriculture. In accordance with its usual terms of coöperative work, the Bureau will share equally with the state the field expenses of this study. Five men have been assigned to it, and the work in the field will be prosecuted through the remainder of the summer.

The Bureau of Forestry fire study includes in its scope everything pertaining to the occurrence, results, prevention, and amelioration of the effects of forest fires in any region. The field force gathers from every responsible source evidence concerning the causes of the fires, the area burned over, and the damage done. Every statement of witnesses is verified, so far as possible, by personal investigation on the ground. It is ascertained whether anti-fire laws are respected or violated, and the attitude of people in the neighborhood is learned—whether because of, or despite their occupations they dread and will fight fires, or whether they think them of little consequence, and perhaps rather wink at their occurrence; for local sentiment is the most powerful agency for causing or controlling forest fires. The fire risk to which capital invested in standing timber is exposed is at best under most conditions a very formidable hazard. It combines inflammability, exposure from camp fires, smudges, careless smokers and railroads, and scanty means of protection—all the qualities which insurance companies avoid in other risks. With the local population indifferent or hostile, the preservation of the forest is almost hopeless. The agents of the Bureau of Forestry are generally most efficient missionaries wherever they go, arousing the people with whom they come in contact to the interest of the community in preventing and putting out fires. From the data which they obtain advice is given as to enactment of more stringent laws, patrol regulations, and methods of fire-fighting.

The results following forest fires are studied to determine whether or not burned-over lands can be made again to produce a forest crop. The first inquiry here is, How badly has the forest been injured? If only the young growth has been killed, the problem is very different from that presented when the ground is swept clean of forest. In the former case, if there are enough seed-bearing trees left, nature requires only protection while she does her work of reforestation. But if the ground has been clean swept, she must be materially assisted if proper forest conditions and growth are to be reëstablished within any reasonable space of time.

The field party in Maine will first investigate the extent of damage which fire has done to the forests. Next it

will examine as to the existence of any natural reproduction of the original forest. Since the worst fires were only a year ago, little in the way of reproduction may be expected in the areas burned over; but what does appear will be carefully noted, and areas in the same district, burned over two, three, four, five, and more years ago, will be compared with each other and with the one-year-old burns. This work is done by taking sample strip acres, laying them off so as to get the best general average of the territory, and then counting all the seedlings and measuring all the trees on these strips. The different kinds of trees encountered and the varying forest conditions, as of soil, etc., are also recorded. In this way an estimate can be formed of how fast natural reproduction takes place.

When this work has been finished the problem remains how to get back a good, dense, normal-growing forest. This is accomplished in one of two ways. The first plan is adopted when the stand of trees is found to be open, scraggy, and in bunches, and consists in helping nature by protecting against fire and stock as perfectly as possible. In addition, the soil may be stirred to aid natural seeding, and, finally, seeds may be scattered on bare spots. The second plan is used where the ground has been swept clean by fire and natural reproduction is almost out of the question. In that case the only resource is tree planting. This is a special branch of the work of the Bureau, and one in which great success has been achieved.

Since nearly all of the timberland of Maine is under private ownership, the results of the study must find their principal application in recommendations to individual landowners. ' But as the Bureau and the state are coöperating in the study, whatever recommendations are made will have added to their scientific value the weight of state interest and approval.

Unless burned-over areas are thus protected and encouraged, forest deterioration is inevitable. An inferior species of tree will usurp the ground and postpone for years, if not forever, a reproduction of the original forest. So that forest fires not only mean immediate and present financial loss in the destruction of timber and young growth, but they also so alter conditions that inferior grades of forest take the place of better growth. It is to escape this double evil that Maine has secured the assistance of the Bureau of Forestry in the coöperative fire study which is now about to begin in earnest.

THE BILTMORE MEASURING STICK.

BY

T. F. PEVEAR.

THERE has recently been brought into use at Biltmore a rather ingenious contrivance for the purpose of measuring the diameters of trees. It consists of a straight stick or ordinary walking cane, upon which are marked off certain ratios corresponding to different diameters, so that by holding the stick horizontally at arm's length against the tree, and sighting toward either side of the tree one can read the diameter directly from the stick. The invention is due to Dr. C. A. Schenck, forester to the Biltmore estate, and the stick has been given a thorough trial, with very good practical results, by the students of the Biltmore Forest School.

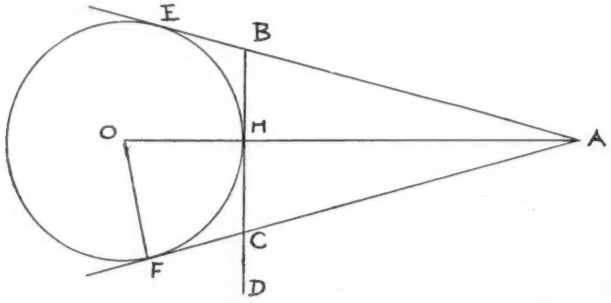
One of the simplest explanations of the mathematical principles involved in the application of the measuring stick is as follows:

In the following figure, suppose A F and A E to be the lines of vision when sighting to either side of the tree, which is represented by the circle whose center is O. B D represent the measuring

stick held horizontally against the tree at arm's length, A H. The lines of vision are tangents to the circle and cut the measuring stick, B D, at B and C, respectively.

To construct the measuring stick for certain diameters:

A H, being the length of the outstretched arm, is known.



O F and O H, being radii of the circle and equal to one-half of the given diameter, are known.

$\therefore$ A O, being equal to A H + O H, is known, and in the right-angled triangle, $AF = \sqrt{AO^2 - OF^2}$.

Since the right triangles A H C and A F O are similar,

$HC : OF :: AH : AF$, or $HC = \frac{OF \times AH}{\sqrt{AO^2 - OF^2}}$

and $BC = 2\,HC$.

When the length, B C, is found, it is measured off on the stick, and the corresponding diameter is written at the point C. In like manner, the ratios are found for other diameters and marked upon the measuring stick. It is obvious that the ratios will differ as arms differ in length, so that the same stick could not be used by every one, but the simplicity of the invention commends it, because a measuring stick that will give good practical results may be easily constructed within ten minutes to fit any length of arm.

Another idea of the inventor is to apply the principle to the helve of an axe, marking off the ratios as on the measuring stick, so that the axe would be useful, not only in marking and felling trees, but also have the added value of being of decided use in measuring their diameters to estimate their contents.

IRRIGATION FOR THE INDIANS.

STUDY OF CONDITIONS IN THE GILA VALLEY — UNDERGROUND WATER SUPPLIES TO SUPPLY PRESENT DEFICIENCY.

THE underground waters of Gila Valley, Arizona, have been recently investigated by Mr. Willis T. Lee, of the United States Geological Survey. The object of the investigation was to ascertain the amount of water available for irrigating the lands of the Indians in this valley. The greater part of the valley is included in the Pima Indian Reservation, on which there are about 7,870 Indians. They are an intelligent, industrious people, and until 1890 they were prosperous. From time immemorial their irrigation canals had been supplied with water from the Gila, but since 1890 the diversion of the Gila waters above the reservation by white settlers has caused a shortage of water. The result is that the area of lands cultivated by the In-

dians has decreased from 14,000 to 7,000 acres and the Pimas and Maricopas of this valley are now impoverished.

To find a remedy for this shortage of surface waters Mr. Lee has carefully studied the geographic relations and geologic conditions of the Gila Valley. He finds evidence that there is an amount of underground water in this region sufficient to saturate the valley soil and still give an overflow of 2,000 inches. This water is probably due to the junction of three underflows—those of Gila, Santa Cruz, and Salt rivers. These are fed from at least three sources—rainfall in the valley, springs from the hillsides, and various streams that enter the valley from the hills, the most important of which is the Gila itself. The quantity of waters held in the gravels at any one time within easy reach of pumps, is estimated at from 1,120,000 to 1,960,000 acre-feet. It is calculated that 40,000 acre-feet of water a year will supply all the present needs of the Indians on the reservation. If the computations are correct, there is now accessible enough water to supply the Indians for at least twenty-eight years. The chemical character of these waters of the underflow is fortunately favorable to their use in irrigation.

Two means of making this water available for irrigation are in use—seepage ditches and pumping plants. Where seepage ditches have been tried the results are disappointing. The quantity of water actually obtained falls far short of expectations; the cost of constructing and maintaining a deep ditch in the loose gravels and quicksands is large compared with the amount of water obtained, and at best only the uppermost part of the underflow is penetrated. On the other hand, Mr. Lee believes that sufficient water can be drawn from the underflow of the Gila Valley by means of pumping to supply the needs of the Indians and also materially to extend the cultivated area without exhausting the available supply. He estimates that ten plants of a capacity similar to that of the one now under construction at Sacaton wil supply the required 40,000 acre-feet a year and allow 36 per cent of the time for stoppage and repairs. Taking the cost of the pumping plants in the Salt River Valley as a criterion, Mr. Lee finds that money spent in the construction of such plants will be safely and profitably invested.

One of the most interesting phases of Mr. Lee's investigation is that on the economic conditions of the Indians. Though peaceful, honest, and industrious, they are lacking in executive ability. They are, however, easily managed and are prosperous when wisely directed. When left to their own devices, they do not properly appreciate or utilize their advantages. At the western half of the reservation their most imperative need is adequate supervision. Their needs at the eastern half are, first, a water supply; second, supervision. It is Mr. Lee's opinion that a water supply without supervision would be unwise.

EXPERIMENTAL FOREST IN MINNESOTA.

BY

GENERAL C. C. ANDREWS,

CHIEF FIRE WARDEN OF MINNESOTA.

AN act of Congress at its last session authorized the State of Minnesota, through its state land commissioner and state forestry board, to select 20,000 acres of third or fourth rate land for experimental forestry purposes, and the selection has been made on the Vermillion range, in townships 64, range 13, and 63, range 13, distant about 12 miles west and northwest of Ely. It is a rugged forest region in a fine lake setting. Most of the surface is underlaid with granite,

upon which the soil is thin. There are hills rising 80 feet above the lakes, making a beautiful landscape. A few elevated areas are almost bare, light-colored granite, but upon which, in the middle of July, was found an abundance of blueberries. In low places the black alder is frequent and there are some swamps of dwarf spruce. In one of these a spruce with a diameter of only one and a half inches was cut showing forty-two rings, thus indicating it was as many years old.

As a whole, the lands are densely covered with thrifty forests from 10 to 30 years of age, of which the prevailing kind is jack pine, though there are groups, though not extensive, of Norway and white pine; and good specimens of both Norway and white pine of merchantable size are found scattered through the woods. Wherever there is a bit of good loamy soil the young white pine is trying to effect a lodgment. Poplar and white birch are frequent, and on the lower lands are spruce and tamarack of considerable value.

Along the lake shores and principal streams the moose and deer have made a trail, which helps the woodman in his progress. There are abundant evidences of wild game. We saw, however, but one moose, who appeared on the lake shore within a hundred yards of our camp at breakfast time.

Within or adjoining these forest-reserve lands are twenty-one lakes, generally deep, and with wooded, rock-bound shores. One of these, locally known as Crab Lake, is noted for its black bass. Some of the land borders the north end of Burntside Lake, which is 8 miles long by 3 or 4 miles wide at its widest place, has many handsome islands, on some of which are cottages of Ely people, and contains trout. Burntside Lake is probably the most beautiful lake in Minnesota. The late Alexander Winchell, of Michigan, said it surpassed in beauty of scenery the Thousand Islands of the St. Lawrence.

As the state's forest, fish, and game preserve this 20,000-acre tract will always afford valuable means of recreation for the public. One can visit these lands by boat all the way from Ely. Streams navigable for boats connect several of the lakes, and with moderate outlay water communication can be extended. It should not be very expensive getting the logs from this reserve to the sawmill at Winton. The most southerly part of the lands are not more than 3 or 4 miles from the Duluth and Iron Range Railroad at Robinson station.

What will be the first steps the state will take with these forestry lands? It will do just as a business man would do if he owned them. It will take pains to protect them from fire, which, in places where the soil lies thin on rocks, would destroy both timber and soil. It will, or should, have a careful survey made of the lands by competent foresters and a map and report made showing the kinds, amount, and value of the timber which should be marketed now and the amount that should be cut in ten and twenty years hence, the proper routes for roads and cost of building, and best ways of getting the timber to market; what portions, if any, of the lands should be artificially stocked with forest and with what kind, and what plan should be adopted for maintaining a sustained yield.

TWELFTH NATIONAL IRRIGATION CONGRESS.

WILL BE HELD AT EL PASO, TEXAS, NOVEMBER 15–18—SPECIAL HALL TO BE BUILT FOR ITS SESSIONS—ATTRACTIVE PROGRAM BEING ARRANGED.

THE committee of arrangements in charge of the Twelfth National Irrigation Congress announces that it will be held at El Paso, Texas, November 15, 16, 17, and 18. That the committee is making big preparations for the Congress is attested by the fact that at a recent meeting the contract was let for the construction of a convention hall capable of seating more than 3,000 peo-

ple. This hall will be completed by October 1, and will then be decorated and furnished in readiness for the session of the Congress.

A statement has just been issued showing that $15,000 will be spent in working up the Congress and providing for entertaining the delegates attending it.

The officers of this Congress are Hon. W. A. Clark, of Montana, president; L. W. Shurtliff, of Ogden, Utah, first vice-president; W. C. Johnson, Denver, Colorado, second vice-president; John Hall, Lampasas Springs, Texas, third vice-president; H. B. Maxson, Reno, Nevada, secretary; C. B. Boothe, of Los Angeles, chairman of executive committee, and Guy E. Mitchell, of Washington, D. C., chairman of press committee.

In order to facilitate the preparations for the Congress and to insure a thoroughly interesting program and the attendance of prominent workers in every line of endeavor closely related to irrigation, the program has been divided into sections.

These sections are Foresty, Land and Water Laws, Irrigation Engineering and Mechanics, Production by Irrigation, and Climatology.

The section of Forestry is in charge of Gifford Pinchot, Forester, United States Department of Agriculture; the section devoted to Land and Water Laws will be in charge of George H. Maxwell, executive chairman of The National Irrigation Association; Engineering and Mechanics, under direction of F. H. Newell, chief of the United States Reclamation Service; Climatology, Willis L. Moore, chief of the United States Weather Bureau, United States Department of Agriculture.

Committee on arrangements at El Paso for the Congress are Hon. W. W. Turney, chairman; Alfred Courchesne, J. R. Harper, Francisco Mallen, John W. Fisher, E. Kohlberg, E. C. Pew, Sr., and A. W. Gifford, secretary.

The entertainment of the visiting delegates to the Congress is being thoroughly planned by the people of El Paso. There will be a carload of fruits and wine for consumption by the delegates, a reception and ball, a barbecue smoker for the men, a bull fight in Juarez, Mexico, just across the Rio Grande River; a roping contest and broncho riding by cowboys, trip to El Paso smelter, the third largest in the United States; Indian sports by Mescalaro, Apaches, and other tribes, and possibly a miners' drilling contest.

A VALUABLE PHILIPPINE CABINET WOOD.

A STRIKING DISPLAY OF NARRA WOOD IN THE PHILIPPINE FOREST EXHIBIT AT ST. LOUIS.

BY

EBER C. SMITH.

A VISIT to the Forestry Building of the Philippine Exhibit at the St. Louis Exposition would be worth the while of any one attending the fair, and particularly those interested in lumbering and the fine-woods industry.

The gathering of this exhibit and the transportation of the same to St. Louis constituted one of the principal items of cost, which aggregated over a million dollars, nearly all of which was paid for out of the treasury of the civil government of the Philippine Islands. Some idea can be formed of its extent and magnitude from the fact that it contains more than 650 different varieties of woods and weighs more than 2,500 tons.

The extensive forests of our new possessions have practically never been touched by the woodman's ax, and today furnishes an excellent opportunity for lumbermen to engage in a sure and lucrative business.

Upon entering the west end of the Forestry Building the visitor will at once be attracted by a highly polished board of narra wood, thirty-six feet long and five feet broad and four inches thick. From this beautiful and magnificent piece of wood one can form an idea of the magnitude of some of our Philippine woods. The narra belongs to the superior group, the male being rose color (from carnation to blood red) and the female white.

It is found on the islands of Luzon, Leyte, Masbate, Mindanao, Mindoro, Negros, Panay, Paragua, and Samar. They form practically virgin forests, the lumber made from this wood having in the past been but little shipped from the islands. It is extensively used throughout the archipelago for flooring by those financially able to obtain it, and also for furniture and housefurnishings. It is very durable and impervious to decay. It is the mahogany of the Philippines and is prettily marked, with a variety of shades, varying from straw-color to blood red, the former being the more common. It is a first-class wood for general purposes. The exhibit contains many other beautiful specimens of this wood. It resists a warm and wet climate and insects which are destructive to many other of the native woods.

It is estimated that a quantity and quality of narra to meet any reasonable demand can be delivered in the log on the beach for seven cents a cubic foot. It is worth in Manila $1.15 a cubic foot and $150 a thousand sawed into lumber.

Many handsome tables made of narra are distributed among the exhibit buildings at the Philippine reserve, the most notable being a round table over nine feet in diameter, being one solid peace of timber. It can be seen in the east wing of the Women's Building, designated "The Typical Manila Building." This wood has a very agreeable odor.

The white narra has a varying color, the most common being ochre yellow, with gray grain, which becomes darker in time, acquiring a grayish yellow, with intermediate tints from red color. The white narra, like the male member of the family, grows into large trees, which will square four feet, but more commonly two feet. Notwithstanding that it is of a more open grain than some of the other fine woods of the islands, it is susceptible of a fine polish, is well and prettily marked, and is in general use for the manufacturing of furniture.

RECLAMATION SURVEY IN NEBRASKA.

EARLY WORK INDICATES THAT FEASIBLE PROJECTS ARE LIKELY TO BE FOUND.

THE report of the engineers who are carrying on investigations looking to reclamation in the valley of the North Platte in western Nebraska shows very satisfactory progress.

Near the Pathfinder dam-site test pits were sunk to ascertain if the foundation was such that a spillway could be built at that point. Granite was found in most of these pits at depths varying from 10 to 13 feet. The formation above the granite is a lime cemented gravel and lies directly on the granite with no intervening strata of other material.

A surveying party made a reconnaissance of the lands along the North Platte River below Caspar, and between Bessemer and Muddy Creek some 5,000 acres of irrigable land were found. This work is being continued. Preliminary surveys were run from the sand-hills east toward Sheep Creek, and a number of routes through the sand-hills were also surveyed. For a great part of the distance the line passes through valleys in which the water will spread out, forming shallow pools, the largest being from 600 to 800 feet long by about 200 feet wide. The cuts through the ridges separating these valleys will not be deep, and the material, which is washed sand, may be sluiced out and deposited in the

LOOKING DOWN THE NORTH PLATTE RIVER FROM THE NEBRASKA-WYOMING BOUNDARY.

next valley below. It was at first believed that the water spreading over so large an area as would be flooded would result in a great loss by seepage and evaporation, but the sediment carried by the canal would in time probably render these valleys nearly impervious.

Farther to the south the valleys are somewhat larger and have a less elevation than those along the line of the first survey. For 9 miles west of the state line the canal will run over a gently rolling country and the cuts in the ridges will not exceed 15 feet from the bottom of the ditch. After the 9 miles mentioned the canal line will encounter a series of gravel ridges in its approach to Rawhide Creek. Preliminary surveys are being made at this point.

A topographic party has been busy mapping the irrigable lands lying on the benches on the north side of the river. Of the 40½ square miles mapped during the month of June, 9,000 acres were classified as first-class lands, 10,000 acres as second class, and 7,000 acres as worthless for cultivation. The 10,000 acres of second-class land as a rule lie well for irrigation, but have a sandy, light soil, like all the land on the benches near Sheep Creek.

These reports show that the canal is practicable, and indicate a feasible cost per acre for reclamation. The difficulties anticipated in getting through the sand-hills near the state line have not materialized, and but few unforeseen difficulties have been met.

THE WATER ELM.

BY

JENS JENSEN.

DURING the summer of 1903 I spent my vacation in that part of the State of Michigan which is generally known as the fruit belt. It was not the fruit industry that had attracted me there, but the sand dunes along the Michigan coast between St. Joseph and South Haven, with their interesting vegetation. The flora along the Black River was also carefully studied, and brought many surprises, being so different from that growing in the same latitude in Illinois. One of the special points of interest in the fruit district is the state experiment farms at South Haven, and it was here I was shown the water elm (*Zelkova acuminata*).

I will let Mr. Farrand, the superintendent in charge of the station, tell the history of the tree: "Seeds of the present trees were received by the late Hon. J. J. Lyon, a well-known horticulturist, in 1879, under the name of Skikiki, and said to be of Japanese origin. The largest one of the trees on the grounds was transplanted young; the other two were moved from another part of the grounds to their present place when quite large, and have never recovered from this transplanting."

The largest tree measured 3 feet 10 inches in circumference over one foot from the ground, and is over 20 feet in height. The trees are growing on level land a few hundred feet from Lake Michigan and about 30 feet above the water level of the lake.

The top soil is a black, sandy loam about 8 inches thick, with a layer of whitish sand to a depth of about 1 foot, and below this a heavy yellowish clay. I was greatly surprised at the presence of such beautiful and thrifty specimens of this Zelkova in Michigan; experience had taught me that it was not hardy at Chicago, although it is farther to the south. It must be admitted here that climatic conditions are more favorable to vegetation on the Michigan side of Lake Michigan than on the Illinois side.

As Mr. Farrand states, the seed was sown in 1879, which made the trees 24 years old when I saw them in 1903. The growth of the larger specimen during the 24 years is one of more than common interest, and gives room to the suggestion, What possibility has the water elm as a forest tree, where climatic and soil conditions are favorable to its growth?

That the larger tree at South Haven had ripened seeds was evident by the seedlings found in a quince hedge close to the tree. Mr. Farrand related that he had never paid much attention to the flowers and seeds, but remembered that it had been covered with small seed pods during the summer of 1902. The circumstances under which the seedlings had been able to germinate rather tends to a prolific reproduction under favorable conditions.

The great value of the lumber of this species for building material, its hardiness and fast growth, and the possibilities for reproduction should stimulate inquiries as to its practical value for forest planting.

As an ornamental tree, its value is not questioned. The smaller tree illustrates well how much trees suffer by being transplanted after years of growth—a habit so much in vogue among tree planters.

Zelkova acuminata is indigenous to the mountains of Japan; another species, *Zelkova crenata* (the Siberian elm), is a native of the Caucasus.

THE RECLAMATION OF ARIZONA.

HAS THE HEARTY APPROVAL OF GOVERNOR BRODIE, WHO MAKES VALUABLE SUGGESTIONS FOR THE WORK.

THE Honorable Alexander A. Brodie, governor of Arizona, is in hearty sympathy with the aims and purposes of the Reclamation Service. As chief officer of a commonwealth that embraces large tracts of arid land, he appreciates the benefits that will follow a system of scientific irrigation. In response to an invitation from the Director of the United States Geological Survey, he has recently made some pertinent suggestions in regard to the work of measuring streams and investigating the water resources of the territory for irrigation purposes.

Next to the Salt River dam, which is now in process of construction, Governor Brodie thinks that the Colorado River project is the most important. There is no greater area of irrigable land in the Southwest, he declares, than that along the Colorado River from above Needles to the Mexican border. The available land continues in vast stretches after the river has departed at Yuma for the sea. This river frequently overflows its banks and damages crops in the cultivated section about Yuma. It would, therefore, seem advisable to provide means for storing its flood waters. Governor Brodie also advocates the construction of a levee from the town of Yuma to the Mexican line to prevent the overflow of the river.

He suggests that the water supply of the Santa Cruz Valley be investigated, that proper attention be given to the artesian belt in San Pedro Valley, and that the numerous small reservoir sites in different parts of the territory be exploited. He thinks it would be advisable to extend the surveys already begun to the upper stretches of the Salt and Gila rivers for the purpose of locating available reservoir sites on those streams and their tributaries. The same might also be said of the Little Colorado River, which takes its rise in the vicinity of the White Mountains, in the eastern part of Arizona. It is probable that on all these streams and their tributaries reservoir sites may be found where flood waters could be stored for use on lands in the valleys below. Subsidiary dams might be constructed in the upper tributaries of streams, and assistance thus rendered to those farmers who are struggling with uncertain water supplies.

Governor Brodie also thinks it advisable that surveys for the location of underground water supplies should be extended. These will be useful in furthering irrigation enterprises dependent on power-pumping plants.

In connection with Governor Brodie's suggestions, it is interesting to note the announcement of Mr. N. H. Darton, chief of the Survey's western division of hydrology, that provision will soon be made for a study of the waters in the Santa Cruz and San Pedro valleys.

RECENT PUBLICATIONS.

New England Ferns and Their Common Allies. By HELEN EASTMAN. Illustrated. Published by Houghton, Mifflin & Co., Boston, Mass. $1.25 *net.*

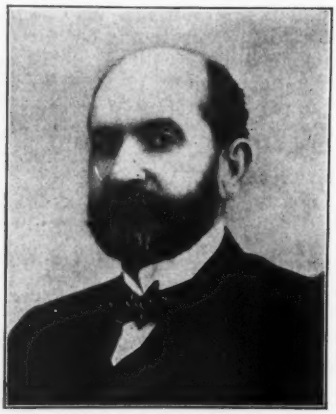
The ferns, always of interest to botanists, do not, however, come in for the share of critical study they should. This book by Miss Eastman should do a lot to spread a desire for more careful study of this interesting family of plants.

This volume is a guide to all the ferns of New England and some of their allies—club-mosses, horsetails, etc. It contains brief and untechnical descriptions of over sixty species or varieties of ferns, with eleven of the allies, and points out more distinguishing marks of difference between species resembling each other than are found in any other work. The illustrations, of which there are nearly fifty, are from direct prints of specimens on photo-

graphic paper and are absolutely accurate. It is believed that they will prove more helpful to beginners than any series of fern pictures that has heretofore appeared. The book is provided with an index and a glossary, and also tables listing the species fruiting in each month of the season and showing what species may be looked for in each particular kind of soil and environment.

The American Natural History. A foundation of useful knowledge of the higher animals of North America. By WILLIAM T. HORNADAY. 300 illustrations from photographs and original drawings. Numerous diagrams and maps. Over 400 pages, double column, 5½ by 8 inches. New York: Charles Scribner's Sons. $3.50. Postage extra.

William Temple Hornaday, author of "The American Natural History," is the director of the New York Zoölogical Park. He has also to his credit several other volumes, including a "Guide to the New York Zoölogical Park," "Two Years in the Jungle," "Taxidermy and



W. T. HORNADAY, AUTHOR OF THE "AMERICAN NATURAL HISTORY."

Zoölogical Collecting," "Free Rum on the Congo," etc. The present book is the result of many years of study, research, and observation among the wild animals of this continent. It is written in a popular manner; in scope and arrangement it is scientific. The author has tried to make clear the place of each mammal, bird, reptile, amphibian, and fish in nature's system, and has clearly described his subjects. The book is written for the teacher, the student, and the general reader, and takes the place between the "nature book" and the zoölogy. The author relates here and there throughout the book anecdotes and personal experiences and observations. There are 200 original drawings by Beard, Rungius, and Sawyer; 100 photographic reproductions by Sanborn, Keller, and Underwood, and numerous diagrams and maps. The greater number of the illustrations have been made expressly for the work, which is further provided with indices.

How to Make a Flower Garden. Manual of practical information and suggestions. Published by Doubleday, Page & Co., New York. Price, $1.60 *net*. Illustrated.

It is doubtful if the amateur gardener can find more of profit in the reading of a single volume than is given in this handsome publication. It is made up of chapters by expert gardeners, including L. H. Bailey, Sarah Hopkins, Warren H. Manning, William Verbeck, and a score of others.

The book covers practically every branch of the subject, and there are many accounts of garden making in various sections of the country based upon actual experiences. The appendices alone, for the different lists of flowers and shrubs they contain suitable for all purposes and seasons, are worth more than the price of the volume to the average gardener. The illustrations, over one hundred half-tones in number, add much to the value of the book.

Baby Pathfinder to the Birds. By HARRIET E. RICHARDS and EMMA G. CUMMINGS, members of American Ornithologists' Union. Paper, 30 cents; leather, 50 cents. W. A. Butterfield, publisher, 59 Bromfield street, Boston.

A pocket guide to bird identification. Just the thing for beginners in bird study and for busy people. It describes one hundred and ten of the land birds of New England, is printed in clear type on thin paper, and illustrated by pen and ink drawings. The birds are grouped in families, prefaced by a descriptive paragraph of family characteristics. Then follows a concise description of each member that is commonly a resident, a visitor, or a migrant in Massachusetts. Alternate pages are left blank for personal notes. Certainly one of the most useful nature books we have seen.

PUBLICATIONS RECEIVED.

U. S. Department of Agriculture, Weather Bureau, Bulletin M, "The Floods of the Spring of 1903 in the Mississippi Watershed." By H. C. Frankenfield. Washington: Government Printing Office, 1904.

U. S. Department of Agriculture, Weather Bureau, Bulletin No. 33, "Weather Folklore and Local Weather Signs." By Edward B. Garriott. Washington: Government Printing Office. Price, 35 cents.

Department of Agriculture, Kingdom of Belgium. "Agriculture: Agricultural Education." Printed by Charles Bulens, Brussels, for distribution at the World's Fair, St. Louis, 1904.

U. S. Department of the Interior, Geological Survey, Bulletin No. 230, "A Gazetteer of Delaware." By Henry Gannett. Washington: Government Printing Office, 1904.

DEPARTMENT OF THE INTERIOR, U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C., JULY 19, 1904. Sealed proposals, in duplicate, will be received until 2 o'clock p. m., August 25, 1904, at the office of D. W. ROSS, Engineer U. S. Geological Survey, Boise, Idaho, for the furnishing of 14,000 barrels of Portland Cement at Minidoka, Idaho. Specifications, forms of proposal, and particulars may be obtained upon application to D. W. Ross, Boise, Idaho, and to the Chief Engineer, U. S. Geological Survey, Washington, D. C. Each bid must be accompanied by a certified check, payable to the order of the Secretary of the Interior, for two per cent of the contract price, as a guaranty that the bidder will, if successful, promptly execute a satisfactory contract and furnish bond in the sum of 50 per cent of the contract price for the faithful performance of the work. The right is reserved to reject any and all bids, waive technical defects, and to accept one part and reject the other, as the interests of the service may require. Bidders are invited to be present. THOS. RYAN, *Acting Secretary.*

DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C., JULY 15, 1904. Sealed proposals, in duplicate, will be received at the office of the United States Reclamation Service, Roswell, New Mexico, until 2 o'clock p. m., September 6, 1904, for the construction of one earthen dam, retaining embankments, spillways, gates, and pipe conduits, and 3½ miles of canal, for the purpose of conducting the flow of water of the Hondo River to a reservoir at a point 12 miles southwest from Roswell, New Mexico. Plans and specifications may be examined and forms of proposal obtained by application to the Chief Engineer of the Reclamation Service, Washington, D. C., or to W. M. Reed, Roswell, New Mexico. Each bid must be accompanied by certified check for 2 per cent of the amount of the bid, payable to the Secretary of the Interior, as a guaranty that the bidders will, if successful, promptly execute a satisfactory contract and furnish bond in the sum of 20 per cent. of the contract price for the faithful performance of the work. The right is reserved to reject any or all bids, to waive technical defects, and to accept one part of the bid and reject another, as the interest of the service may require. Bidders are invited to be present at the opening of bids. Proposals must be marked "Proposals for Reservoir, Canals, etc., Hondo River, New Mexico." THOS. RYAN, *Acting Secretary.*

DEPARTMENT OF THE INTERIOR, UNITED STATES GEOLOGICAL SURVEY, RECLAMATION SERVICE, WASHINGTON, D. C., JULY 29, 1904. Sealed proposals, in duplicate, will be received at the office of the U. S. Reclamation Service, at Montrose, Colorado, until 10 o'clock a. m., September 15, 1904, for the construction of about 15 miles of main distributing canals, involving about 700,000 cubic yds. of earthwork, for the conveyance and partial distribution of about 1,300 cubic feet of water per second from the mouth of the Gunnison Tunnel, near Cedar Creek station, to a point on the Uncompahgre River about 9 miles south of Montrose, Colorado. Bids will be received on excavation and embankment for one or more divisions which will approximate 50,000 cubic yards each. The right is reserved to award to one bidder as many or as few of such divisions as the interest of the service may require. Specifications, form of proposal, and plans may be inspected after August 10, 1904, at the office of the Chief Engineer of the Reclamation Service, Washington, D. C., at the office of the District Engineer, U. S. Reclamation Service, Chamber of Commerce Building, Denver, Colo., and at the office of the U. S. Reclamation Service, Montrose, Colo. Each bid must be accompanied by a certified check for 5 per cent of the amount of the bid, payable to the Secretary of the Interior, as a guaranty that the bidders will, if successful, promptly execute a satisfactory contract and furnish bond in the sum of 50 per cent of the bid for the faithful performance of the work. The right is reserved to reject any or all bids, to waive technical defects, or to accept one part of a bid and reject another, as the interests of the service may require. Bidders are invited to be present. Proposals must be marked "Proposals for the construction of South Canal, Uncompahgre Valley Project." THOS. RYAN, *Acting Secretary.*

DEPARTMENT OF THE INTERIOR, UNITED STATES GEOLOGICAL SURVEY, RECLAMATION SERVICE, WASHINGTON, D. C., JULY 29, 1904. Sealed proposals, in duplicate, will be received at the office of the U. S. Reclamation Service, at Montrose, Colorado, until 10 o'clock a. m., October 5, 1904, for the construction of the Gunnison Tunnel and approaches, involving 30,000 linear feet, more or less, of tunnel and about 120,000 cubic yards of excavation in open cut at the lower portal, the same being a portion of a system for the diversion of about 1,300 cubic feet of water per second from the Gunnison River to the Uncompahgre Valley, Colorado. Specifications, form of proposal, and plans may be inspected after August 10, 1904, at the office of the Chief Engineer of the U. S. Reclamation Service, Washington, D. C., at the office of the District Engineer, U. S. Reclamation Service, Chamber of Commerce Building, Denver, Colo., or at the office of the U. S. Reclamation Service, Montrose, Colo. Each bid must be accompanied by a certified check for $10,000, payable to the Secretary of the Interior, as a guaranty that the bidders will, if successful, promptly execute a satisfactory contract and furnish bond in the sum of $150,000 for the faithful performance of the work. The right is reserved to reject any or all bids, and to waive technical defects, as the interests of the service may require. Bidders are invited to be present. Proposals must be marked "Proposal for the construction of the Gunnison Tunnel, Uncompahgre Valley Project." THOS. RYAN, *Acting Secretary.*

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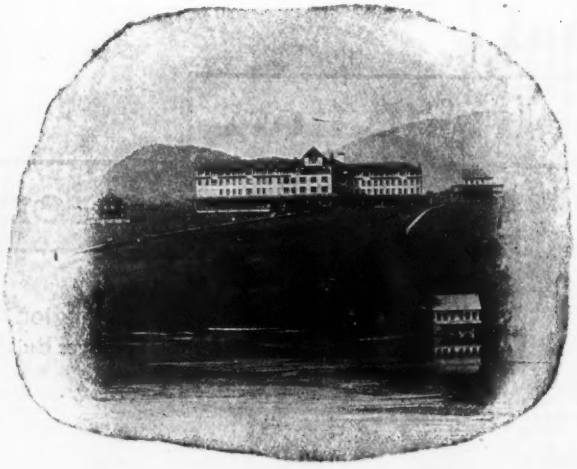

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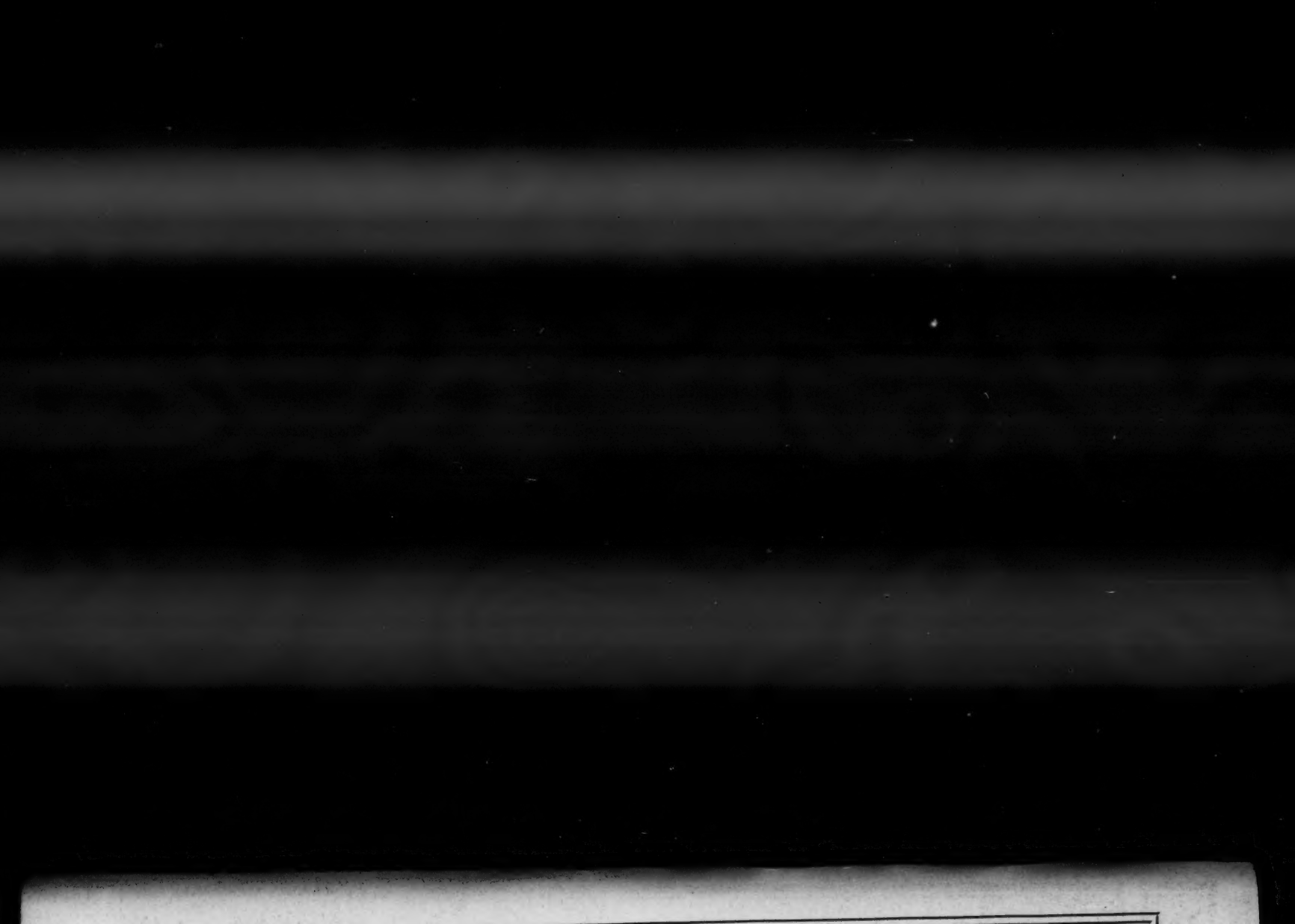
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